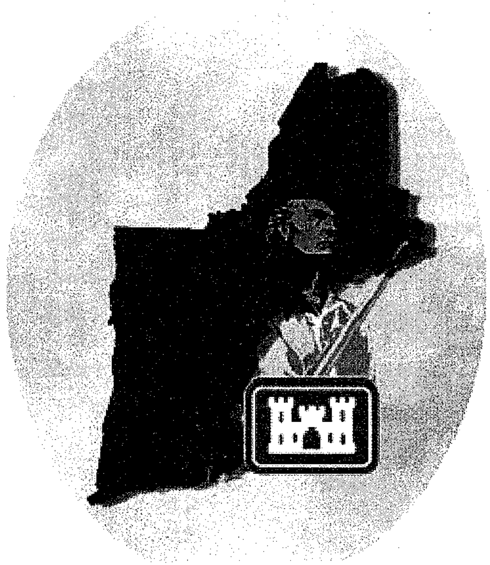
US Army Corps of Engineers®

Final Third Five-Year Review Report For Silresim Superfund Site City of Lowell Middlesex County, Massachusetts

September 2009

Prepared by



Geo-Environmental Branch
Engineering/Planning Division
New England District
Concord MA

Approved by:

James T. Owens III, Director
Office of Site Remediation and
Restoration.

Date: 9/8/09

EXECUTIVE SUMMARY

The original remedy for the Silresim Superfund Site (Site) in Lowell, Massachusetts is comprehensive consisting of both management of migration (MOM) and source control (SC). The MOM portion of the remedy consists of extraction and treatment of contaminated groundwater. Source Control includes excavation of off-property soils and placement on the site under an approved cap, operation of a soil vapor extraction system to reduce the volatile organic compound (VOC) source and implementation of appropriate institutional controls. This Five-Year Review has found that those components of the remedy that have been performed are consistent with the requirements of the Record of Decision (ROD).

The Groundwater Treatment Plant has been operational since its construction in November 1995. Based on the most recent comprehensive groundwater sampling report, the total quantity of VOCs removed since its construction is 104 tons. The excavation of off-property soils containing non-VOC contaminants above cleanup levels was completed in the fall of 2004. The final cap design was approved in 2008.

An Explanation of Significant Differences (ESD) was issued in September 2008 which identified thermally-enhanced Soil Vapor Extraction (SVE) as the preferred Source Control remedy. MassDEP supports this remedial approach. A contractor Statement of Work (SOW) and Final Electrical Resistance Heating (ERH) Treatment Zone Evaluation Report were completed in 2008 and 2009, respectively, by the U.S. Army Corps of Engineers (USACE). It is anticipated that the ERH treatment will be performed within the next two years.

Institutional Controls are presently in place for much of the Site; these are required based on the presence of soil and groundwater contamination above unrestricted-use levels. Pending the completion of the Source Control remedy, modification of the ICs may be necessary

This is the third five-year review for the Site. The trigger for this review was the signature date of September 9, 2004 on the preceding five-year review.

All immediate threats at and from the Site have been addressed. The comprehensive remedy is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site name: Silresim Chemical Corp.		
EPA ID: **MAD000192393**		
Region: 1	State: MA	City/County: Lowell/Middlesex

SITE STATUS	
NPL status: **X** Final Deleted Other (specify)	
Remediation status (choose all that apply): Under Construction **X** Operating **X** Complete	
Multiple OUs?* YES **X** NO	Construction completion date: Ongoing
Has site been put into reuse? YES NO **X**	

REVIEW STATUS	
Lead agency: EPA **X** State Tribe Other Federal Agency ______________________	
Author name: Katherine Malinowski	
Author title: USACE Chemist	**Author affiliation:** U.S. Army Corps of Engineers New England District
Review period:** 09/ 09/2004 – 04/30/2009	
Date(s) of site inspection: 11/25/2008	
Type of review: **X** Post-SARA ____ Pre-SARA ____ NPL-Removal only ____ Non-NPL Remedial Action Site ____ Regional Discretion ____ NPL State/Tribe-lead	
Review number: 1 (first) 2 (second) 3 (third) **X** Other (specify) __________	
Triggering action: ____ Actual RA Onsite Construction Actual RA Start at OU# ____ ____ Construction Completion Previous Five-Year Review Report **X** ____ Other (specify)	
Triggering action date *(from WasteLAN)*: 09/09/2004	
Due date (five years after triggering action date): 09/09/2009	

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

FIVE-YEAR REVIEW SUMMARY FORM, CONT'D.

Issues:

1. The sewer line trench, which traverses the North Study Area, may serve as a preferential pathway for the migration of contaminated groundwater. Existing (limited) data does not support this is occurring; however, this could affect the future protectiveness of anyone whom may come in contact with this groundwater if this were occurring.

2. Increasing contaminant trends in some monitoring wells in the North Study Area suggest that the pumping strategy may be potentially ineffective in managing plume migration from the Central to North Area.

3. Institutional Controls may need to be updated.

4. Vapor intrusion is a potential concern in areas north of the site; however, provided property use and zoning remain the same (re: industrial), this remains an incomplete exposure pathway.

Recommendations and Follow-up Actions:

1. Verify the depth and location of the sewer line trench located north of the site. Generate additional information (sampling and/or groundwater flow data, as necessary) to determine if this is a potential source of off-site migration of site-related contaminants.

2. Increase frequency of groundwater monitoring of wells in the North Study Area and continue to evaluate modifications to the extraction wells pumping strategy.

3. Update ICs, as necessary, pending the completion of additional planned Source Control activities.

4. Continue to evaluate, no less than annually, abutting property uses, zoning, and groundwater monitoring data as they relate to the potential for vapor intrusion into indoor air.

Protectiveness Statement(s)

All immediate threats at and from the site have been addressed. The comprehensive remedy is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Long-term protectiveness of the remedial action will be verified by continuing the on-going groundwater monitoring program, and annual assessment of abutting property usage. Portions of the plume that may have migrated beyond the extraction well array [in the north area] are being monitored and additional monitoring data are being generated. The remaining other three areas (East, South, and West Study Areas) monitoring data indicate that the plume is entirely contained.

Other Comments:

Post-thermal treatment, optimization of extraction and monitoring wells will be necessary. In addition, nuisance odors identified by the project team should be sampled and analyzed to ensure worker safety and compliance with Occupational Health and Safety Administration (OSHA) workplace standards. The USACE recommends the exposure pathway for municipal sewer workers to the treated effluent from the Site be evaluated to confirm long-term protectiveness.

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LIST OF ABBREVIATIONS AND ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
BAV	Benchmark Assessment Value
bgs	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability
CFR	Code of Federal Regulations
COCs	Contaminants of Concern
COPCs	Contaminants of Potential Concern
CSF	Cancer Slope Factor
CUGs	Cleanup Goals
CVOC	Chlorinated Organic Compound
CZA	Capture Zone Analysis
EPA	United States Environmental Protection Agency
ERH	Electrical Resistance Heating
ESD	Explanation of Significant Differences
EW	Extraction Well
gpm	Gallons per minute
GWTP	Groundwater Treatment Plant
GZA	Goldberg-Zoino & Associates, Inc.
HDPE	High density polyethylene
HHRA	Human Health Risk Assessment
IRIS	Integrated Risk Information System
LE&S	Lowell Iron & Steel
LTRA	Long-Term Response Action
MADEQE	Massachusetts Department of Environmental Quality Engineering
MADWPC	Massachusetts Department of Water Pollution Control
MassDEP	Massachusetts Department of Environmental Protection
MCLs	Federal Maximum Contaminant Levels
MCP	Massachusetts Contingency Plan
mg/kg	milligrams per kilogram
MOM	Management of Migration
MRS	Metals Removal System
MSL	Mean Sea Level
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operations and Maintenance
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
POTW	Publicly Owned Treatment Works
PPE	Personal Protection Equipment
Ppb	Parts per billion
Ppm	Parts per million
PRPs	Potentially Responsible Parties
RA	Remedial Action

RAC	Response Action Contract
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SC	Source Control
SDWA	Safe Drinking Water Act
SVE	Soil Vapor Extraction
SVOC	Semi-volatile Organic Compound
TBC	To be considered
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TtFW	Tetratech Foster Wheeler, Inc.
TTO	Total Toxic Organics
TTVO	Total Toxic Volatile Organics
UCL	Upper Concentration Limit
µg/kg	Microgram per kilogram
µg/L	Microgram per liter
USACE – NAE	U.S. Army Corps of Engineers New England District
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound

1.0 INTRODUCTION

1.1 Regulatory Background

The United States Environmental Protection Agency (EPA) must implement five-year reviews consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This is the third five-year review for the Silresim Superfund Site (Site) (Figure 1). This review is required by statute since the Site consists of a post Superfund Amendments and Reauthorization Act (SARA) remedial action that, upon completion, will leave contaminants at the Site above levels that allow for unlimited use and unrestricted exposure.

The trigger for the first five-year review was the commencement of remedial action (i.e., construction of the Groundwater Treatment Facility) in 1994. The trigger for this review was the signature date of September 9, 2004 on the preceding five-year review.

CERCLA §121(c), as amended, states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The NCP part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

1.2 Purpose of the Five Year Review

The purpose of this five-year review is to determine whether the remedy for the Silresim Superfund Site is protective of human health and the environment. Specifically, the report addresses the following 3 questions stated in EPA's Five-Year Review Guidance Document (OSWER No. 9355.7-03B-P):

Question A: Is the remedy functioning as intended by the decision documents?

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

The findings and conclusions of this review are documented in this report. The report identifies issues found during the five-year review period and offers recommendations.

1.3 Personnel Conducting the Review

The U.S. Army Corps of Engineers (USACE) was tasked by the USEPA, Region I, to complete a Five-Year Review at the Silresim Superfund Site in Lowell, Massachusetts. This report was prepared in accordance with an approved scope of work consisting of a cost estimate and schedule, dated December 12, 2008. The review was conducted between November 2008 and June 2009.

The site was visited on November 25, 2008. Participants in the site visit included:

Name	Representation	Discipline
Daniel Keefe	USEPA Region 1	Remedial Project Manager
Janet Waldron	Mass DEP	Project Manager
Cynthia Hanna	USACE	Risk Assessor
Katherine Malinowski	USACE	Chemist/Lead Author
Ian Osgerby	USACE	Remedial Process Engineer
Rosemary Schmidt	USACE	Geologist/Geology and Chemistry Section Chief
John Haley	Watermark Environmental, Inc.	Project Manager

2.0 SITE CHRONOLOGY

The chronology of the Site, including all significant Site events and dates is included in Table 1.

Table 1. Chronology of Site Events.

EVENT	DATE
Facility used as oil and fuel storage depot.	1916-1971
Facility used for chemical waste reclamation and later for hazardous waste collection and treatment by Silresim Chemical Corporation. MADWPC (now MassDEP) inspections find repeated permit violations, attempts to shutdown Silresim.	1971-1977
Silresim bankrupt, facility abandoned, leaving one million gallons of hazardous materials on-site in drums, tanks and tanker cars.	1978
Over 30,000 drums were removed from the Site.	1981-1982
Facility listed on National Priorities List by USEPA for long term cleanup.	1983
Site structures removed, security fence extended, and clay cap placed over the Site.	1984
Remedial Investigation/Feasibility Study (RI/FS) process initiated by 185 PRPs (Silresim Site Trust).	1985
Remedial Investigation/Feasibility Study Report and Risk Assessment completed.	1990
Record of Decision (ROD) issued by USEPA.	1991
USACE/EPA/MassDEP begin construction of Groundwater Treatment Facility with Foster Wheeler Environmental Corporation.	1994
Groundwater Treatment Facility begins continuous operation.	1995
Soil Vapor Extraction Pilot Test completed.	1996
Cap upgrade and drainage improvements completed.	1998
State determination that the groundwater is not suitable as a drinking water source.	1998
Phase I Soil Vapor Extraction Operations completed.	1998-1999
ROD Remedy Review and Five-Year Review completed recommending amendments to Cleanup Goals and remedial actions.	1999
Additional Site Investigation and Revision of Site Cleanup Goals completed.	2001
ERH Pilot Test completed.	2002-2003
Explanation of Significant Differences (ESD) completed amending groundwater and soil clean-up goals (CUGs)	September 2003
Flushing model completed to determine length of time the GWTP would need to run post SVE treatment	March 2004
Second Five-Year Review Completed by USEPA Region I	2004
Off- site surface soil contamination excavated and disposed of on the Silresim Property	2004
Off-site confirmatory soil boring sampling showed no exceedances of the upper concentration limits (UCLs) in soil or groundwater	August 2007
Long-term response action (LTRA) responsibilities transferred from USEPA to the Commonwealth of Massachusetts through the MassDEP	September 24, 2007
Explanation of Significant Differences (ESD) completed with additional amendments to the CUGs and a change to the selected source control remedy to thermally-enhanced soil vapor extraction (SVE)	September 2008
Final Technical Memorandum Treatment Zone Evaluation for Silresim Superfund Site Completed	April 2009
Third Five-Year Review Completed by USEPA Region I (this report)	September 2009

3.0 BACKGROUND

This section includes the Site's physical characteristics and resources potentially affected by the Site as well as contamination history. The initial response discussing the sequence of events leading to the NPL listing of the Site and the ROD are also discussed in this section. The final sub-section lists the chemicals in each media which require remediation.

3.1 Physical Characteristics

The Site (inclusive of the extent of groundwater contamination) is comprised of approximately 16 acres in an industrial area of Lowell, Massachusetts, just south of the City's central business district (Figure 1). The 4.5-acre Silresim property, outlined by the fence line in Figure 2, was formerly owned and operated by the Silresim Chemical Corporation (Silresim) at 86 Tanner Street, and groundwater and soil contamination extend to other nearby properties. The property is bordered by the Lowell Iron & Steel (LIS) Company to the north, the Boston and Maine (B&M) railroad yard and tracks to the east/northeast, an automobile salvage yard to the south and Tanner Street to the west. Residential areas are located south, east and northeast of the Silresim property, with the closest residences located on Canada, Main and Maple Streets, roughly 300 to 500 feet from the Silresim Property boundary. River Meadow Brook is located approximately 400 feet west of the Silresim property and flows northeast and discharges into the Concord River. The Concord River joins the Merrimack River approximately 1 mile northeast of the Site. East Pond, a small, surface water body, is located about 300 feet to the east of the Silresim property.

An 8-foot high chain link fence surrounds the Silresim property. Most of the land surface within the fence is covered with a clay cap. Crushed stone has been placed on runoff areas along the northern and southern perimeter of the Silresim property to prevent direct contact with dioxin contaminated soils. The groundwater treatment plant (GWTP) required by the 1991 Record of Decision (ROD) occupies the central portion of the Silresim property and commenced operation in November 1995. The 10-year long-term remedial action (LTRA) period expired on September 24, 2007 and operation of the treatment plant has since been transferred to the Commonwealth of Massachusetts acting through the Massachusetts Department of Environmental Protection (MassDEP).

Geology consists of alternating layers of sandy silt and silt with thin clay layers (varves), overlying till, over bedrock. Bedrock is on the order of 100 feet (ft) deep below ground surface (bgs) under most of the Site, but rises to shallower depths north of the Site. The Site is located over the buried pre-glacial Merrimack River bedrock valley, which passes from west to east in this area.

The conceptual model of the Site consists of six hydrostratigraphic layers numbered 1 through 6 from the surface downward. The cross section of the six layers are shown on Figure 5 from the transect A-A' which is shown on the Site Diagram, Figure 2. The six layers are based on the Site's sediment textures, stratigraphy and depth to bedrock, with layer elevations as idealized in the numerical groundwater flow model that was developed for the site (MODFLOW). The following are descriptions of the layers:

Layer 1 is the uppermost layer (10 – 15 feet below ground surface depending on location within the site), terminating at a lower elevation of 95 feet NGVD. This layer is primarily fine sand or fill.

Layer 2 extends from elevation 95 feet NGVD downward to 75 feet NGVD. Layer 2 is characterized by varved clayey lacustrine silt deposited in a glacial lake quiet water environment. In general the lacustrine silt in layer 2 is characterized by low hydraulic conductivities and high anisotropy ratios meaning the vertical hydraulic conductivity is much lower than the horizontal hydraulic conductivity. The clay varves (layers) are absent north of the site, representing either a slightly different depositional environment lacking a cyclical deposition of finer-grained material, or possibly some degree of later reworking of material in this area by glacial meltwater stream flows.

Layer 3 extends from 75 feet NGVD downward to 50 feet NGVD. This layer is primarily silty fine sand in the southern and central portions of the Site and fine sand in the northern portion of the Site. This layer has the highest hydraulic conductivities at the Site.

Layer 4 extends from 50 feet NGVD downward to 20 feet NGVD and consists of varved clayey lacustrine silt similar to Layer 2. This layer has a low hydraulic conductivity and high anisotropy ratios.

Layer 5 is a layer of till, typically on the order of 15 feet thick, lying below Layer 4 on top of the bedrock surface, from elevation 20 feet NGVD to 5 feet NGVD.

Layer 6 is defined by the bedrock underlying the entire Site below 5 feet NGVD.

It is important to note that the layers are not as continuous in the area north of the Site where there is a dramatic rise in the bedrock surface, and Layers 1 and 2 directly overlie till and bedrock.

3.2 Land Resource and Use

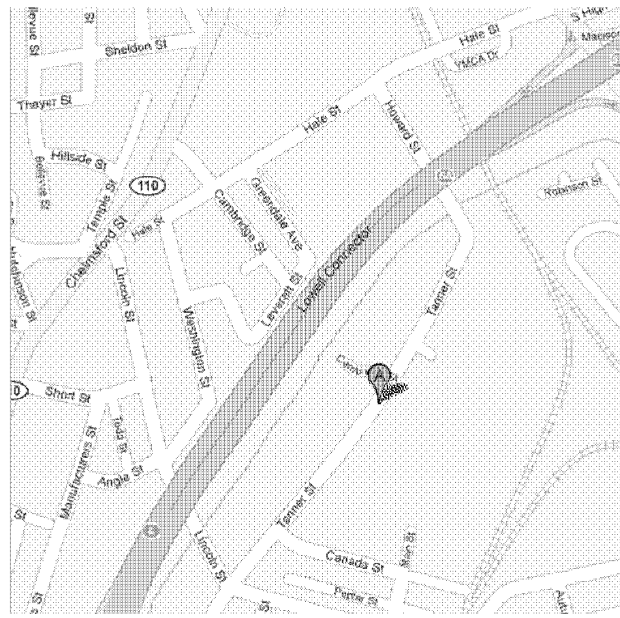
The City of Lowell considered the conceptual future use of the Silresim property and determined it is most-likely to be commercial/industrial as are the properties which abut the site. This was memorialized in a letter to EPA from the City Manager dated June 2007. Accordingly, recreational use of the site is no longer being considered. The commercial/industrial properties surrounding the Silresim property also are expected to continue to be used for similar purposes in the future; however, future redevelopment of these properties is possible, including the construction of new buildings. Groundwater is assumed to remain unused for consumptive and non-consumptive purposes. In regard to abutting properties, institutional controls (ICs) were obtained in the form of property restrictions contained in easements obtained by the PRPs in 1995. In general, for all the adjacent properties, the restrictions prohibit any groundwater withdrawal for drinking water purposes and require that prior to any construction activities or activity that would withdraw groundwater, the property owner shall notify EPA.

Shallow groundwater flows radially from a mound typically located near the northeast corner of the fenced area of the Site. At depth, the predominant groundwater flow direction at the Site is to the north and northwest. River Meadow Brook is the most-likely surface water discharge point for site groundwater. There are no known public or private wells in the surrounding area. MassDEP completed a groundwater use and value determination consistent with the EPA's 1996 Final Groundwater Use and Value Determination Guidance. The MassDEP determined a "low" use and value for the groundwater beneath the Site. More specifically, groundwater under most of the site (except within 30 feet of an occupied structure) is considered GW-3. A GW-3 designation considers the impacts and risks associated with the discharge of groundwater to surface water, and therefore applies to all groundwater. Groundwater that is within 15 feet of the ground surface and within 30 feet from an occupied structure, is said to be classified as GW-2; this classification was developed in consideration of the potential for migration of vapors from groundwater to indoor air.

There has been a change in property ownership since the last review. The owner of Lowell Iron and Steel now also owns the Boston and Maine Railroad property (See Figure 3). There are plans for a new gas and oil power plant to be built on property adjacent to the Site, northeast of parcel 2 on Figure 3.

In November 2007, the City of Lowell received funding through the Superfund Redevelopment Initiative. Among other things, this funding was used to evaluate infrastructure improvements along Tanner Street. One such project was the Innovative Storm Water Project (Watermark, 2007). The object of the design was to improve the storm water drainage system in the Tanner Street area and incorporate some concepts from an earlier redevelopment study to revitalize the area. The report included suggested drainage improvements along Tanner Street between Canada Street and Howard Street (see map insert below for street locations), modifications to the cap to make the Site more accessible for re-use, and reapportioning the site into three parcels (Figure 3). The three parcels and the proposed different methods of final cap construction are described in the Final Cap Evaluation Report (Ttec, 2007). Reapportioning of the Silresim property into three parcels would create more advantageous parcels for future reuse of the property, specifically the area on the east (rear) of the Silresim property (referred to as Parcel 2). The Miserlis family (the original owners of the Silresim property) still owns the entire Silresim property and is delinquent in their paying of real estate taxes. In addition, there are numerous other property liens that would likely have to be relieved prior to any future redevelopment.

So far, the only improvements to the Tanner Street drainage system have been approximately 500 feet south of the Site. The intersection of Canada and Tanner Streets is as far north as improvements to the system were done. See street locations on adjacent map (Google™ maps, 2009). The Site location is marked as “A”. The Lowell Regional Wastewater Utility (LRWU) put a large drainage system that empties into River Meadow Brook to help with drainage separation. The surface water drainage system coming from the Site discharging into River Meadow Brook was installed as part of the construction of the interim cap.



3.3 History of Contamination

The Site and its surrounding areas have been used for industrial activities since the early 1900s. From 1916 to 1971, several petroleum companies used the Silresim property as an oil and fuel storage depot. Adjacent parcels have contained oil storage terminals, a foundry, steel fabrication equipment, a sales facility for used auto parts, coal storage facilities and railroad operations. From 1971 through 1977, Silresim operated its chemical waste reclamation facility. The facility's primary operations included recycling and reclaiming various chemicals and consolidating wastes for off-site disposal. The Massachusetts Division of Water Pollution Control (DWPC) granted the facility a hazardous waste collection and disposal permit in 1973. Wastes were accepted at the facility in drums, tank trucks, railroad tanker cars, and other containers. These substances included halogenated solvents, oily wastes, alcohols, plating wastes, metal sludge, and pesticide wastes. Although exact figures do not exist, it is estimated that the facility handled approximately 3 million gallons of waste per year.

Silresim filed for bankruptcy in late 1977 and abandoned the facility in January 1978, leaving behind approximately one million gallons of hazardous materials in drums and bulk tanks, including almost 30,000 decaying drums covering virtually all open areas of the 4.5-acre Silresim property.

Typically, the highest levels of contamination are concentrated in a thin layer (typically 2-ft thick) just at the water table, sorbed to the fine-grained material at the top of a varved clay layer. The water table typically occurs at a depth of about 10 ft bgs. An area north of the existing groundwater treatment plant has been characterized as having deeper penetration of contamination to depths of at least 50 feet. Groundwater flow is radial in the shallow zone, from a high located in the northeast corner of the site, and then at greater depth joins regional flow patterns from south to north. Free product non-aqueous phase liquid (NAPL) has been reported in several Site wells.

3.4 Initial Response

From 1978 to 1982, DWPC erected a fence around the Site, hired a 24-hour guard, removed liquid wastes in drums and aboveground tanks, constructed berms and absorbent-filled trenches to reduce the spread of waste through surface runoff, and conducted a series of studies of Site soils and groundwater.

In 1982, EPA proposed the Site for inclusion on the National Priorities List (NPL) and the Site was subsequently listed on the NPL in 1983. In 1983, EPA monitored the air and sampled soils and groundwater, and found contamination both on and off the Silresim property in soil and groundwater. In 1984, EPA raised the height of the fence and covered the Silresim property with 9 inches of crushed gravel and a clay cap. Subsequent sampling revealed an additional area of soil contamination that EPA similarly secured by extending the fence to prevent exposure. In 1986, EPA identified dioxin and the fence was reconstructed to prevent access by the public, and a gravel cover was placed over the dioxin-contaminated soil to prevent exposure by direct contact.

Between 1985 and 1990, Remedial Investigation (RI) and Feasibility Study (FS) activities were conducted to further characterize the Site. The RI assessed the type and extent of contaminants present and included human health and ecological risk assessments. Field activities conducted as part of the RI included monitoring well installation and the collection and analysis of groundwater, soil, sediment, surface water, and air samples. Soil sampling from areas beneath the clay cap as well as outside the fence determined the extent of soil contamination. The RI identified approximately 100 individual contaminants in on-site groundwater and soils. Volatile organic compounds were the primary contaminant type identified. Other contaminants which were identified included: semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), metals, herbicides, pesticides and dioxin. Subsequent risk assessments were completed which evaluated the potential impacts from Site contaminants to human health and the environment. The RI provided baseline data required to evaluate potential clean-up actions.

In September 1991, EPA issued the ROD for the Site. The comprehensive remedy selected in the ROD called for in-situ soil-vapor extraction (SVE). Soils with residual contamination (post-SVE treatment) would be consolidated, stabilized, and capped on-site. Contaminated groundwater would be extracted and treated by metals removal, air stripping, and vapor treatment prior to discharge to the City sewer system. In early 1993, a Consent Decree between EPA and a group of potentially responsible parties (PRPs) was executed. Under this Consent Decree, the PRPs provided approximately $41 million in clean-up funding for the Site of which approximately $28 million was identified for Remedial Action and $13 million was given to the Commonwealth for long-term operation and maintenance (O&M) of the GWTP and cap.

Construction of the GWTP began in mid-1994 and groundwater extraction and treatment has been underway since November 1995. Initial response actions, including the installation of fencing and covering areas of contamination, have reduced the potential for accidental exposure and further migration of contaminated soils. Approximately 2,000 cubic yards of surface soil contamination at off-property locations was consolidated onto the Silresim property and placed under an interim cap; this work was completed in 2005.

3.5 Summary of Basis for Taking Action

Hazardous substances that have been released at the site in each media include:

Surface Soil	**Subsurface Soil**	**Groundwater**
1,1,2,2-Tetrachloroethane Trichloroethene 1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenz(a,h)anthracene Hexachlorobenzene 1,2,4-Trichlorobenzene 2,3,7,8-Tetrachloro-dibenzo-p-dioxin equivalents PCBs (Aroclors 1242 & 1254) Arsenic Lead Mercury	Benzene Chlorobenzene Chloroform 1,2-Dichloroethane 1,1-Dichloroethene Ethylbenzene Methylene Chloride Styrene 1,1,2,2-Tetrachloroethane Tetrachloroethene Toluene 1,1,1-Trichloroethene 1,1,2-Trichloroethane Trichloroethene Vinyl Chloride 1,2-Dichlorobenzene Hexachlorobenzene Naphthalene 2,3,7,8-Tetrachloro-dibenzo-p-dioxin equivalents PCBs (Aroclor 1242) 1,2,4-Trichlorobezene Lead Mercury	Vinyl Chloride Acetone 1,1-Dichloroethene Methylene Chloride 1,2-Dichloroethene (total) cis-1,2-Dichloroethene Chloroform 1,1,1-Trichloroethane 1,2-Dichloroethane Benzene Trichloroethene 1,1,2-Trichloroethane Tetrachloroethene Chlorobenzene Ethylbenzene 1,1,2,2-Tetrachloroethane Naphthalene 1,2,4-Trichlorobenzene Arsenic Cadmium Lead Nickel

4.0 REMEDIAL ACTIONS

The remedy selection for source control (SC) and management of migration (MOM) is discussed in this section. Remedial actions for SC and MOM along with pertinent clean-up goals are described below. The system operation and maintenance for the MOM is also discussed in this section.

4.1 Clean-up Goals

The 2003 Explanation of Significant Differences (ESD) predominantly amended groundwater and soil Clean-Up Goals (CUGs) based on changes in chemical toxicity information as well as a Groundwater Use & Value Determination prepared by the MassDEP. The determination was for low use and low value designation for the groundwater impacted by the Site (MassDEP, 1998).

A second ESD was issued in September 2008 which includes further updates to CUGs and redefines the selected SC remedy as thermally-enhanced SVE to better account for the low permeability of soils and the high moisture content. Based on the 2007 correspondence from the City of Lowell regarding the potential future uses of the Site and updated toxicological data, CUGs were recalculated. The previous CUGs (in the 2003 ESD) were based, in part, on exposure pathways that have either been eliminated or are not complete. Specifically, the City of Lowell envisions this property will be reused for commercial/industrial purposes and is no longer considering recreational reuse for this property. Other changes in the development of CUGs include the elimination of a railroad worker's exposure as this potential exposure is similar to exposure of a construction or utility worker. Lastly, based on indoor air sampling at an abutting property (LI&S) as well as observations as part of a recent property use assessment (2008), the indoor air migration pathway is currently considered incomplete, but will continue to be monitored. EPA observed that various chemicals, paints, lubricants, waste oils and/or solvents are used routinely by the various abutters to the Silresim property. Based on EPA Draft Guidance for Evaluating Vapor Intrusion (November 2002), at commercial/industrial settings, the 2008 ESD assumed that the potential risk for workplace-related exposure fell under the purview of OSHA, and that the determination of site-related contaminants would be exceedingly difficult based on these recent observations. Accordingly, as recommended in the Guidance, the VI pathway is said to be incomplete and periodic (annual) assessment of property use was recommended and is being implemented. Refer to Section 6.4.4 for additional details regarding the evaluation of indoor air and the vapor intrusion pathway.

The revised CUGs are included in a report entitled, "Supplemental Clean-up Goal Evaluation" dated May 2008. The revised CUGs are protective of utility, construction, industrial/commercial workers, and trespassers and are listed in Appendix B as Table 1 (Surface Soil), Table 2 (Subsurface Soil) and Table 3 (Groundwater). The revised CUGs vary compared to the 2003 ESD clean-up levels because, despite eliminating some exposure pathways (i.e., indoor air migration), there were changes in a number of toxicological values for certain contaminants of potential concern. Therefore, some of the revised CUGs in 2008 are more stringent and some are less stringent than before. These CUGs are highlighted to show this in Tables 1-3 in Appendix B. The Supplemental Clean-up Goal Evaluation also identified 1,4-dioxane as a chemical of potential concern (COPC), which has been added to the list of contaminants that have CUGs.

The exposure scenarios and associated exposure parameters used to assess current and future potential derive CUG remain protective and are summarized in Appendix E, Table 1.

4.2 Remedy Selection

The original remedy in the ROD is comprehensive consisting of both SC and MOM components. Each is discussed in more detail below. There are phases of remedial action that have been completed. To address the excavation of off-property surficial soils containing VOCs and non-VOC contaminants above cleanup levels, excavation of off-site soils was completed in the Fall of 2004. Surficial soils contaminated with VOCs were excavated to a depth of one foot. Soils contaminated with non-VOCs above MassDEP Upper Concentration Limits were excavated from several "hot spot" areas from depths greater than 1 foot. This activity was designated as OU2 in the 2003 Explanation of Significant Differences (ESD). The excavation and management of off-site contaminated soil is documented in a September 29, 2005 letter and a report attached to that letter entitled "Interim Remedial Action Report Source Removal OU2 Surficial Soils" (USEPA, 2005).

Source Control

Source control activities specified in the ROD included the construction, start-up, and operation of a Soil Vapor Extraction (SVE) system to remove VOCs from unsaturated zone soils. Air permeability and SVE pilot tests were conducted at the Site from July 1995 to December 1996. SVE pilot tests were conducted using three techniques: conventional SVE, heated air injection, and high vacuum or multiphase SVE. In general, extracted vapor flow rates for the extraction wells (< 9 standard cubic feet per minute) and radii of influence (< 2-3 feet at some locations) were less than expected. A Phase I SVE program focusing on maximizing the removal of VOC mass was implemented from October 1998 through December 1999. This resulted in the removal of an estimated 12 tons of VOCs from the subsurface; however, the effectiveness of the SVE system was limited because the Site was not sufficiently de-watered, soil moisture content was high, and low permeability soils were encountered. It was subsequently concluded that conventional SVE would be unable to significantly reduce groundwater clean-up time frames. Accordingly, operation of the SVE system was terminated.

The 1991 ROD also specified that the final cap would be constructed using a design consistent with State and Federal closure requirements for a RCRA facility. As discussed in the Final Cap Design report dated September 2008 (Ttech, 2008) protection of human health and the environment can be achieved by substantively meeting the performance requirements of an Engineered Barrier (a man-made structure that typically includes an earthen cover and that is intended to meet the performance objectives) as defined by 310 Code of Massachusetts Regulations (CMR) 40.996(4)(c).

An Engineered Barrier that will be protective of human health and the environment will be constructed on the Silresim property. As defined in 310 CMR 40.996(4)(c), an Engineered Barrier means a permanent cap with or without a liner that is designed, constructed, and maintained in accordance with scientific and engineering standards to achieve a level of no significant risk for any foreseeable period of time. In order to meet the specific performance criteria for an Engineered Barrier, any proposed capping system:

1. Shall prevent direct contact with contaminated media;
2. Shall control any vapors or dust emanating from the contaminated media;
3. Shall prevent erosion and any infiltration of precipitation or runoff that could jeopardize the integrity of the barrier or result in the potential mobilization and migration of contaminants;
4. Shall be comprised of materials that are resistant to degradation;
5. Shall be consistent with the technical standards of RCRA Subpart N, 40 CFR 264.300, 310 CMR 30.600 or equivalent standards:
   a) provide long-term minimization of migration of liquids through the closed landfill;

b) function with minimum maintenance;
c) promote drainage and minimize erosion or abrasion of the cover;
d) accommodate settling and subsidence so that the cover's integrity is maintained; and
e) have a permeability less than or equal to the permeability of the bottom liner system.

6. Shall include a defining layer that visually identifies the beginning of the barrier;
7. Shall be appropriately monitored and maintained to ensure the long-term integrity and performance of the barrier; and
8. Shall not include an existing building, structure or cover material unless it is designed and constructed to serve as an engineered barrier pursuant to the requirements of 310 CMR 40.0996(4).

The following alternatives were chosen as discussed in the Final Cap Evaluation Report (TteC, 2007). The Final Cap Design was approved by EPA on September 26, 2008.

• Parcel 1 – (Alternative 1) No action, existing soil cap with no alterations or upgrades.
• Parcel 2 – (Alternative 4b) Relocate stockpiled contaminated soil and regrade property, install full thickness of soil Separation Layer required by Engineered Barrier Guidance, and add a "demarcation" layer.
• Parcel 3 – (Alternative 1) No action, existing soil cap with no alterations or upgrades.

<u>Management of Migration</u>

The ROD outlined the following objectives for the GWTP to extract and treat the contaminated groundwater.

• Manage the migration of contaminated groundwater toward downgradient receptors of local building basements, River Meadow Brook, and East Pond;

• Capture as much of the contaminated plume as possible; and

• Drawdown the groundwater across the Site to support the Source Control (SC) remedy. (The drawdown of groundwater across the Site was ineffective and consequently the original SVE SC remedy was ruled out.)

4.3 Remedy Implementation

Applicable CUGs and SC and MOM remedies are discussed in this section.

4.3.1 Management of Migration

The groundwater extraction system has been unable to achieve the original drawdown objective across the Site (as contemplated in the ROD). However, the GWTP continues to operate and remove significant quantities of VOCs. Based on the most recent comprehensive groundwater sampling report, Draft Status Report 33 dated March 2009, approximately 4177 pounds of total volatile organics were removed during the period from September 1, 2008 to February 5, 2009; the total quantity of volatiles removed since the plant's construction is 104 tons. The National Priorities List (NPL) geographically defines the Silresim Site as the extent of contamination that includes approximately 16 acres containing groundwater contamination (USEPA, 1991). Despite mass removal via pump and treat technology, the plume remains relatively widespread and includes both on- and off-property locations.

Status Report 33 summarizes the current MOM trends. Overall, the contaminant concentrations observed in the monitoring wells located in the surrounding study areas appear to be primarily stable or decreasing with the exception of four wells in the North Study Area and eight wells in the Central Study Area. Concentrations in excess of the Site's CUGs were measured in four of the eight wells sampled in the North Study Area during the January 2009 sampling event. These wells show increasing or potentially increasing trends in total Volatile Organic (TVO) and individual compound concentrations.

Continued treatment via groundwater pump and treat is required. Based on a report entitled Evaluation of Future Groundwater Flushing (March 2004), it was anticipated that attainment of groundwater clean-up goals utilizing Pump and Treat (P&T) technology alone may take several hundred years.

4.3.2 Source Control

To address the lack of effectiveness of the selected SC remedy and the long timeframe of pump and treat remediation required, an evaluation of alternative methods of treatment was performed. Several technologies were considered; however, only Electrical Resistance Heating (ERH) was considered as a viable option for a pilot test. ERH is a thermally-enhanced application of SVE that employs electrical current to heat both the underlying soil and groundwater; this heating of the contaminated media liberates substantially more contamination which can then be captured, treated, and/or destroyed.

ERH was pilot tested from October 2002 to January 2003. The results of the pilot test concluded that while it may be a substantially long time (> 100 years) to meet groundwater clean-up goals for all contaminants in all layers beneath the site, a significant reduction for the majority of contaminants can be achieved for most substances in the most-contaminated layers. Based upon the evaluation, the first significant change memorialized by the 2008 ESD was the substitution of thermally-enhanced SVE such as ERH to replace traditional SVE as the cleanup technology for soil.

A Final ERH evaluation and remedial design for this technology was completed by the U.S. Army Corps of Engineers (USACE). This evaluation includes an assessment of the cost-benefit of various ERH implementation scenarios. The benefit is quantified both in terms of cost per pound [of VOC] removed, as well as the potential anticipated savings associated with a reduced timeframe in which the GWTP will need to operate. The complete ERH evaluation is in the "Final Technical Memorandum Treatment Zone Evaluation for Silresim Superfund Site, Lowell, Massachusetts" dated April 19, 2009. It is anticipated that the ERH treatment will be performed within the next two years.

Institutional Controls are present on the abutting properties and further modifications may be required after the completion of the additional SC remedy. Implementation of ERH on the property could reduce the timeframe required for ICs to be in place on some of the properties. A pilot test of ERH conducted on LI&S for 90 days removed 1,500 pounds of VOCs and reduced shallow groundwater VOC contamination by greater than 99%. The additional source removal might also help achieve cleanup goals in areas of the site that are downgradient from the most-contaminated areas of the Site, and more easily ensure that the plume is contained on the Silresim property itself.

Another change documented in the 2008 ESD with respect to SC is the ROD's provision for the stabilization/solidification of up to 18,000 cubic yards of soil. As part of the recent evaluation of the design for the final cap at the site, EPA determined that the anticipated cap design is sufficient to reduce contaminant mobility and comply with applicable and/or relevant and appropriate requirements and that the additional reduction to contaminant mobility afforded by stabilization is not required.

4.4 System Operation/Operation and Maintenance

The primary goal of the GWTP is to manage the migration of contaminated groundwater as required in the ROD. This includes maintaining a constant hydraulic gradient in the direction of the extraction wells in order to reduce the migration of the contamination plume from the Site.

The GWTP continues to be effective in the removal of contaminants from the waste stream and continues to meet all water and air discharge requirements. The water is discharged to the Lowell Regional Wastewater Utility (LRWU). The VOC discharge concentrations are based on a monthly limit of 2.13 ppm total volatile organics (TVO).

The evaluation of reduced or modified influent treatment (re: Appendix F, Status Report 31, Watermark, Inc., 2007b) in regards to effluent discharge to the Tanner Street sewer included a partial risk assessment that assumed sewer worker exposure. The sewer worker was not evaluated as part of the remedial investigation (RI) Human Health Risk Assessment (HHRA). Further evaluation is warranted to confirm that this is a complete pathway and to evaluate potential risks.

Proactive O&M of the GWTP has allowed operational runtime to be maximized. Major O&M changes implemented during this five-year period include:

- Effluent discharge volume limit increase: A request was submitted to the LRWU for an increase in the effluent discharge volume limit to provide for greater hydraulic control of the plume. The LRWU granted an effluent discharge volume limit increase from 50,400 gallons per day (35 gpm) to 57,600 gallons per day (40 gpm) in August 2004.

- Extraction well variable frequency drives (EW VFDs) were upgraded: The original EW VFDs were installed in 1995, at GWTP startup. The upgraded newer model VFDs were installed for EW- 17, 19, 20, 21, 27, 28, 29, 30 and 31.

- Memory modules were added to the programmable logic controller (PLC) to update the software. Without these upgrades, the program code was susceptible to erasure. With these modules the program will remain intact and service visits to the Site will be very limited.

- The GWTP staffing was changed on February 4, 2006. A GWTP operator is no longer required to be on-site on a weekend day. Currently the GWTP is manned Monday – Friday from 5:30 a.m. to 3:30 p.m.

- The Thermal Oxidizer (TOX) Heat Exchanger and exhaust piping, as well as the Quench Tower received a complete visual inspection as part of a preliminary evaluation to determine which vapor treatment equipment was in need of replacement. The insulation on the outside of the TOX exhaust piping was replaced (it had been removed to visually inspect all of the TOX components). The TOX Heat Exchanger was replaced in November 2007 based on the inspection findings. The TOX Heat Exchanger insulation and rain cover were installed in July and August 2008.

- EW-18 was reactivated (after being taken offline in 2000). A packer was also installed to seal off the lower portion of the existing screen. The primary purpose of reactivating this well was to increase mass removal in Soil Layer 3 (75-50 feet NGVD).

- The Industrial Sewer User Permit was renewed on December 1, 2006. The new Permit with the LRWU will expire on November 30, 2010 and is further described in Appendix G of Status Report #30.

- The air compressor was replaced.

The O&M of the GWTP was transferred to the MassDEP on September 24, 2007.

Capture Zone Analyses (CZAs) were included in Status Report 26 (Watermark Environmental, 2005 (August 6, 2004 – February 5, 2005)) and Status Report 30 (Watermark Environmental, 2007a (August 6, 2006 – February 5, 2007)). In both reports, the CZA indicated there was “incomplete capture from the Central to the North Area in layers 1, 2 and 3”. In regard to the West Area, Status Report 26 indicated there was “incomplete capture from the Central to the West Area in layers 1, 2 and 3,” however; the more recent CZA done for Status Report 30 indicated that “capture is present in all layers located in this area”. In both reports complete capture was demonstrated from the Central to the South Area and from the Central to the East Area.

A remedial process optimization (RPO) evaluation was done for extraction wells 17 and 31 both located in the northern section of the Central Study Area (Figure 2 in Appendix D) in an effort to identify possible operating parameter modifications that could contribute to the overall efficiency of the GWTP. Results of this RPO evaluation, reported on December 22, 2008, indicated that there is flexibility in operating parameters at both EWs 17 and 31 that could benefit the site goal of contaminant source removal without affecting the other primary goal of maintaining MOM at the Site.

Table 2. Annual system operations/O&M Costs.

Dates		Total Cost Rounded to Nearest $1,000
From	**To**	
January 2004	December 2004	$1,331,000
January 2005	December 2005	$1,388,000
January 2006	December 2006	$1,374,000
January 2007	December 2007	$990,000
September 24, 2007	August 31, 2008	$1,213,000[a,c]
September 1, 2008	June 2009	$956,000[b,c]

[a] - Long-term response action (LTRA) responsibilities transferred from USEPA to the Commonwealth of Massachusetts through the MassDEP on September 24, 2007.
[b] – Cost is an estimate
[c] – Costs are not inclusive of DEP staff costs

5.0 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

This section summarizes the protectiveness statements, recommendations and follow-up action since the last review.

5.1 Protectiveness Statements from Last Review

All immediate threats to the Site are being addressed and the remedy is expected to be protective of human health and the environment after groundwater cleanup goals are achieved through continued operation of the groundwater treatment plant. However, time frames to achieve CUGs are anticipated to be much longer than 30 years.

Long Term Protectiveness:

Long term protectiveness of the remedial action will be verified by continuing the ongoing groundwater and air/vapor monitoring programs, both on the Silresim property and in downgradient areas. Portions of the plume have migrated beyond the extraction well array and are being closely monitored. Current monitoring data indicate that the effectiveness of the extraction well array has been improved. Current monitoring data indicates that the plume now appears to be largely contained. Current data also indicate that the remedy is functioning as required but will require much longer than 30 years to achieve CUGs.

5.2 Status of Recommendations and Follow-Up Actions from the Last Review

Issue from Previous FYR	Recommendations and Follow-Up Actions	Actions Taken	Date of Action
The Remedy Will Not Achieve Cleanup Goals in Time Frames Anticipated by the ROD	Continue to Optimize GWTP Operation	GWTP optimization efforts are tracked in the Status Reports under the section on improvements, modifications and adjustments to the extraction and monitoring well arrays. The status optimization recommendations are tracked in Table 9 of the Status Reports.	Ongoing
Groundwater Plume VOC Vapor Intrusion into Buildings	Develop Well Defined Vapor Intrusion Monitoring Program Consistent with Recent EPA and MassDEP Guidance	VIP Evaluation done at LI&S and B&L Used Auto Parts LI&S indoor air was tested in 2004 (results acceptable). In 2005 the B&L Used Auto Parts building was inspected (further sampling deemed unnecessary due to industrial background interferences). Evidence of possible plume migration near the LI&S buildings necessitates continued groundwater monitoring as well as continued annual assessment that property uses have not changed.	LI&S Testing (2004) and B&L UAP Evaluation (2005) both documented in a letter report dated 2007. Property Use Assessment at LIS and Scannel Boiler Works (2008)
Elements of the Core of the VOC Plume on Silresim and LI&S Properties Remain Highly Contaminated	Review Adequacy of Institutional Controls for Long Term Site Operation	ICs in place are in the form of easements written in 1993 and 1994. These are considered adequate for the current land use and industries adjacent to the site. The groundwater impacted by the Site was determined to be low use and value by the MassDEP. However the MassDEP believes groundwater treatment is necessary for the Site to prevent exposure to contaminated groundwater and to prevent further migration.	Easements (1995) Low Use and Value Determination October 1998 and corresponding letter to the EPA – May 8, 2003
Very Limited Data to Support Remedial Alternatives Evaluation for Non-Contained Plume Elements	Develop Plan to Collect Data to Assess Natural Attenuation	In Fall of 2006, 29 monitoring well samples were analyzed for Natural Attenuation parameters to establish a baseline data set to be used for future evaluations of the natural attenuation capacity of the Site.	November 2006
Future Site Protectiveness Relies Significantly on Institutional Controls	Review Overall Adequacy of Institutional Controls Site-Wide	ICs in place are in the form of easements. These are considered adequate for the current land use and industries adjacent to the site.	Easements (1995)

Issue from Previous FYR	Recommendations and Follow-Up Actions	Actions Taken	Date of Action
The Remedy Will Not Achieve Cleanup Goals in Time Frames Anticipated by the ROD	Periodically Evaluate Potential Source Control Remediation Technologies	ERH was pilot tested from October 2002 to January 2003. The results of the pilot test concluded that while it may be a substantially long time (> 100 years) to meet CUGs for all contaminants in all layers beneath the site, a significant reduction for the majority of contaminants can be achieved in the most-contaminated layers. MassDEP stated a preference for ERH treatment in a letter dated June 15, 2007. An ERH evaluation and remedial design was completed by the USACE in April 2009 and implementation is expected within the next 2 years.	2002-present
Downgradient Plume Shape Adjacent to River Meadow Brook – Not Completely Defined	Continue Monitoring with Potential for Additional Monitoring Wells	MW-714 was sampled six times between November 2001 and January 2005. The contamination concentrations show a decreasing trend. The most recent sampling shows that concentrations are below CUGs.	2001-2008
1,4-Dioxane, a Solvent Stabilizer has not been Analyzed for in Groundwater	Conduct Limited Groundwater Monitoring for 1,4-Dioxane	1,4-Dioxane has been added as a new COPC since the last five-year review. The recommended CUG for 1,4-dioxane in the Supplemental Clean-Up Goal Evaluation is 37 mg/L (Ttech, 2008). The compound was monitored in the Central, North and South Study Areas in select monitoring and extraction wells. Tables 5 and 6 show the results of the 1,4-dioxane groundwater sampling.	2005 & 2006

6.0 FIVE YEAR REVIEW PROCESS

This five-year review was conducted in accordance with USEPA's most current five year review guidance (USEPA, 2001). Tasks completed as part of this five-year review include review of pertinent site-related documents, interviews with parties associated or familiar with the site, an inspection of the site, and a review of the current status of regulatory or other relevant standards.

6.1 Administrative Components

The Five Year Review Team was led by Dan Keefe, EPA Remedial Project Manager (RPM), and included members from the USACE with expertise in geology, chemistry, remedial process engineering, and risk assessment. Janet Waldron of MassDEP and John Haley of Watermark Environmental assisted in the review.

In November 2008, the review team established the review schedule whose components included:

- A review of site background, land use, history of contamination, and response actions.
- A site visit.
- Review of remedy selections and implementation.
- Interviews with local officials and interested parties.
- Review of changes to toxicity values and Applicable or Relevant and Appropriate Requirements (ARARs) since the previous Five Year Review.
- Review of progress since the last Five Year Review.
- Review of historic LTRA operations, maintenance, and monitoring data.
- Technical assessment of the remedy.
- Determination of Remedy Protectiveness.

During the course of the third Five-Year Review, the Review Team completed the following tasks:

- Reviewed Status Reports, technical memorandums and other letters and documents describing Site characteristics and events that took place within the review period.
- Visited the Site to inspect remedy components and effectiveness.
- Interviewed local officials, and other interested parties.
- Assessed historical data and reports as well as current groundwater data.
- Developed the Five-Year Review Report.

6.2 Community Involvement

The 2008 ESD and supporting information were made available for public review at the local public repository and via the internet. In addition, a Notice of Availability of the ESD was published in a local newspaper on July 28, 2008 marking the beginning of the 30-day public comment period. During the comment period, no public comments were received. Interviews were conducted and documented on interview forms (Appendix A). The Administrative Record of Site Documents is available to the public at the following locations:

USEPA
Records Center
One Congress Street
Boston, MA 02114

Pollard Memorial Library
401 Merrimack Street
Lowell, MA 01882

6.3 Document Review

Documents reviewed to prepare this five-year review report included all Status Reports from the past five years and other Site-related information and memos listed in the Reference Section of this report (Section 11.0). This section also lists the ARARs for the Site and changes in the toxicity values since the May 2008 CUG evaluation (see Table 3).

6.3.1 Background Documents Review

Site-related documents reviewed as part of this effort are listed in the Reference Section of this report (Section 12.0).

6.3.2 Review of ARARs

Applicable or Relevant and Appropriate Requirements (ARARs) for the Silresim Chemical Corp., Superfund Site were identified in the ROD (USEPA, 1991) and include the following:

- Chemical Specific Federal Standards
    - Safe Drinking Water Act (SDWA)
    - RCRA – MCLs - 40 CFR Part 264.94
    - Clean Air Act (CAA) NAAQS for Total Suspended Particulates – 40 CFR 50; NAAQS for Hazardous Air Pollutants – 40 CFR 1 to 99
- Chemical Specific State Standards
    - Massachusetts Groundwater Quality Standards – 314 CMR 6.00
    - Massachusetts Drinking Water Regulations – 310 CMR 22.00
    - Massachusetts Ambient Air Quality Standards – 310 CMR 6.00
    - Massachusetts Air Pollution Control Regulations – 310 CMR 7.01 and 7.02 (2)(a), 310 CMR 7.06, 310 CMR 7.09, 310 CMR 7.10, 310 CMR 7.18
    - Massachusetts Prevention and/or Abatement of Air Pollution Episode and Air Pollution Incident Emergencies 310 CMR 8.00
- Location-Specific State Standards
    - Massachusetts Wetland Protection Act (WPA) Regulations – 310 CMR 10.00
    - Massachusetts Hazardous Waste Facility Siting Regulations – 990 CMR 1.00

- Action Specific Federal Standards

    - Clean Air Act (CAA) NAAQS for Total Suspended Particulates – 40 CFR 50, NAAQS for Hazardous Air Pollutants – 40 CFR 1 to 99
    - Clean Water Act (CWA) National Pollution Discharge Elimination System (NPDES) – 40 CFR 122 and 125, General Pretreatment Regulations for Existing and New Sources of Pollution – 40 CFR 403
    - Fish and Wildlife Coordination Act – 16 USC 661
    - Resource Conservation and Recovery Act (RCRA) Subtitle C, 40 CFR 260, 40 CFR 264.30-264.37, 40 CFR 264.50-264.56, 40 CFR 264.90-264.101, 40 CF 264.110-264.120, 40 CFR 264.250-264.259, 40 CFR 264.300-264.317, 40 CFR 268
    - Toxic Substance Control Act (TSCA) – 40 CFR 761

- Action Specific State Standards

    - Massachusetts Ambient Air Quality Standards – 310 CMR 6.00
    - Massachusetts Air Pollution Control Regulations – 310 CMR 7.01 and 7.02 (2)(a), 310 CMR 7.06, 310 CMR 7.09, 310 CMR 7.10, 310 CMR 7.18
    - Massachusetts Prevention and/or Abatement of Air Pollution Episode and Air Pollution Incident Emergencies – 310 CMR 8.00
    - Massachusetts Hazardous Waste Regulations – 310 CMR 30.00, 310 CMR 30.500 and 30.561, 310 CMR 30.580, 310 CMR 30.590, 310 CMR 30.620 to 30.633, 310 CMR 30.640, 310 CMR 30.660, 310 CMR 30.680 and 30.690
    - Massachusetts Right To Know – 105 CMR 670.00, 554 CMR 21.00
    - Massachusetts Hazardous Waste Activity Notification – 310 CMR 33.00
    - Massachusetts Surface Water Discharge permit Requirements – 314 CMR 3.00
    - Massachusetts Surface Water Quality Standards – 314 CMR 4.04, 314 CMR 4.06(2)
    - Massachusetts Certification for Dredging, Dredged Material Disposal and Filling in Waters – 314 CMR 9.00
    - Massachusetts Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharge – 314 CMR 12.00

- Additionally, the ROD identifies the following as “To-Be Considered” criteria:

    - SDWA, NPDWR – 40 CFR 141
    - EPA Reference Doses (RfD) for Noncarcinogens
    - EPA Lifetime Health Advisories (HAs), Office of Drinking Water
    - SDWA Maximum Contaminant Level Goals (MCLGs) and proposed MCLGs
    - Massachusetts Office of Research and Standards Drinking Water Guidelines (ORSGLs)
    - Federal Clean Water Act (CWA) – Federal Ambient Water Quality Criteria (FAWQC)
    - American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLVs), Time Weighted Average (TWAs), and Short-Term Exposure Limit (STELs)
    - Massachusetts Allowable Ambient Limits (AALs) and Threshold Effects Exposure Limits (TELs)
    - EPA Directive for PCBs (OSWER Directive 9355.4-01)
    - EPA Directive for Lead (OSWER Directive 9355.4-02)
    - Agency for Toxic Substances and Disease Registry (ATSDR) Recommendation for Dioxins
    - Policy, Controls of Volatile Organic Compound (VOC) Emissions from Air Strippers which are used to treat Contaminated Groundwater

Since the previous five year review, some toxicity factors have changed and are listed in Table 3. In addition, due to both toxicity factor and exposure factor changes some of the cleanup goals have changed; these are listed in Appendix B tables.

Some ARARs may also not be relevant at this time, but should be continued to be reviewed in future five reviews because site conditions may change. For instance, since the treated groundwater is not discharged to River Meadow Brook, only surface water from the site is discharged to River Meadow Brook). Therefore, the Massachusetts Certification for Dredging, Dredged Material Disposal and Filling in Waters – 314 CMR 9.00 and the Fish and Wildlife Coordination Act – 16 USC 661 are not currently relevant ARARs.

The Resource Conservation and Recovery Act has been updated since the last five year review (e.g., 40 CFR 264.120 updated through 71 FR 16904 on Apr. 4, 2006) and a training module for Treatment, Storage and Disposal Facilities (September 2005, for 40 CFR Parts 264/e65 Subparts A – E) is now available. The training module is informative and contains information regarding several aspects of the regulation including updates such as EPA's standardized manifest form which became a requirement after September 2006.

6.3.3 Toxicity Characteristics

Several toxicity factors have changed since the last five year review and some chemical toxicities are now unquantified because there is no value supported. Table 3 summarizes the toxicity assessment for the Site since the May 2008 evaluation presented in the CUG Evaluation (TtEC, 2008). The current CUGs are presented in Appendix B in Tables 1, 2, and 3. Appendix B also includes Table 4 which summarizes the toxicity values which changed between the 2003 ESD and the May 2008 Supplemental CUG Evaluation. These toxicity values were used to calculate the revised risk-based May 2008 CUGs. Changes to toxicity factors are due to changes in several toxicity factor resources. These resources are:

◊ Provisional Peer Reviewed Toxicity Values (PPTRV) which are developed by the USEPA's Superfund Risk Technical Support Center
◊ USEPA's Integrated Risk Information System (IRIS)
◊ California Environmental Protection Agency (CalEPA)
◊ USEPA
◊ USEPA's Dioxin Reassessment
◊ Agency for Toxic Substances and Disease Registry (ATSDR)
◊ USEPA's National Center for Environmental Assessment (NCEA)
◊ Massachusetts Department of Environmental Protection (MassDEP)

Table 3. Changes in Toxicity Values Since the May 2008 Supplemental Clean-Up Goal Evaluation Silresim Superfund Site, City of Lowell, Commonwealth of Massachusetts

Toxicity Type	Substance	Current Value (Reference)	May 2008 Value
RfD (mg/kg/-day)	Chlorobenzene (chronic)	2E-02 (IRIS)	Not listed
RfD (mg/kg/-day)	1,2 Dichloroethane	2E-02 (PPRTV)	NA
RfD (mg/kg/-day)	Hexachlorobutadiene	1E-03 (PPRTV)	2E-04 (HEAST)
RfD (mg/kg/-day)	1,1,2,2 Tetrachloroethane	4E-03 (PPRTV)	4E-02 (ATSDR)
RfD (mg/kg/-day)	Trichloroethylene	NA	3E-04 (EPA-NCEA)
RfC (ug/m3)	Acetone	3.1E+4 (ATSDR)	1.3E+4 (ATSDR)
RfC (ug/m3)	1,1,1 Trichloroethane	5E+3 (IRIS)	2.2E+3 (PPRTV)
RfC (ug/m3)	Trichloroethylene	NA	4E+01
RfC (ug/m3)	1,2,4 Trimethylbenzene	7.0E+00 (PPRTV)	6.0E+00
RfC (ug/m3)	1,3,5 Trimethylbenzene	NA	6E+00
Cancer SFo	Chloroform	3.1E-2 (CalEPA)	1.0E-2 (EPA RfD)
Cancer SFo	1,2 Dichloroethane	4.7 E-2 (CalEPA)	NA
Cancer SFo	1,2,4 Trichlorobenzene	3.6E-03 (CalEPA)	NA
Cancer SFo	2,3,7,8 TCDD	1.5 E+05 (HEAST)	1E+06 (EPA draft)
Cancer IUR	1,2 Dichloroethane	2.1 E-5 (CalEPA)	NA
Cancer IUR	Ethylbenzene	2.5E-06 (CalEPA)	NA
Cancer IUR	Cadmium (water)	1.8E-03 (EPA)	NA

ATSDR – Agency for Toxic Substances and Disease Registry
calEPA – State of California Environmental Protection Agency
CancerSFo – Oral Cancer Slope Factor $[(\text{mg/kg-day})^{-1}]$
Cancer IUR – Cancer Inhalation Unit Risk $[(\mu g/m^3)^{-1}]$
HEAST – Health Effects Assessment Summary (USEPA, 1997)
IRIS – Integrated Risk Information System
NA - not available
RfD_{or}- reference dose (mg/kg-day)
RfC – Reference Concentrations ($\mu g/m^3$)
PPRTV – Provisional Peer Reviewed Toxicity Values (USEPA)

6.4 Data Review

Groundwater data and limited soil data were reviewed. There is a brief discussion of surface water in this section; however, there was no surface water data to review. Indoor air samples and evaluations are also summarized below.

6.4.1 Groundwater

The overall groundwater monitoring program has been implemented to provide chemical and hydrogeological data necessary to evaluate the effectiveness of the MOM and groundwater remediation efforts at the Site. Specific objectives of the groundwater monitoring program include the following:

- Characterization of site groundwater chemistry and contamination;
- Characterization and confirmation of site hydrogeology including groundwater flow directions;
- Continued development of a hydrogeological and chemical database to support the on-going evaluation of changes in groundwater quality associated with extraction well pumping, GWTP operations, and the overall progress of MOM efforts.

The Site is divided into five study areas (North, South, East, West, and Central) to provide a more focused discussion of hydrogeologic features, contaminant distribution, and migration. The five study areas are shown on Figure 2 and referred to in this section as the; North Area, South Area, East Area, West Area, and Central Area. The layer delineation described in section 3.1 was used to assign the monitoring wells to specific layers.

Watermark in their status reports evaluates management of migration (or plume capture), based on both hydrogeology (groundwater head data showing inward flow gradients to the extraction wells) and groundwater chemistry (qualitative evaluation of increasing/decreasing trends in concentrations). Both lines of evidence are used to assess the effectiveness of the extraction well array for MOM.

Groundwater levels are measured during the groundwater sampling events (annually). Water levels are reported in each corresponding Status Report. The most recent capture zone analysis (CZA) was done using water level values from March 2007. A capture zone is a three-dimensional region that is created by the pumping of an extraction well(s) such that groundwater within that zone is either stagnant or is drawn towards the extraction well. The Central Area Boundary (Figure 2) is established as a cut-off for MOM discussion purposes. No effort is made to affect any Areas outside of the Central Area Boundary. The MOM goal is to prevent migration away from the Central Area, across the Central Area Boundary.

The physical hydrogeology is discussed by layer. For figures showing the results of the CZA refer to Figures 6-2a-f in Status Report No. 30 (Watermark Environmental, Inc., 2007a). Capture Zone Analyses were included in Status Report 26 (August 6, 2004 – February 5, 2005) and Status Report 30 (August 6, 2006 – February 5, 2007). In both reports the CZA showed incomplete capture from the Central to the North Area in layers 1, 2 and 3. In Status Report 26, incomplete capture was noted from the Central to the West Area in layers 1, 2, and 3; however, the CZA done for Status Report 30 indicated that capture is present in all layers located in the western region of the Central Study Area. In both reports complete capture was demonstrated from the Central to the South Area and from the Central to the East Area. A remedial process optimization (RPO) evaluation was done for extraction wells 17 and 31 in an effort to identify possible operating parameter modifications that could contribute to the overall efficiency of the MOM at the Site. Results of this RPO evaluation were reported on December 22, 2008 in Status Report No. 33.

Routine groundwater monitoring has been conducted at the Silresim Superfund Site since a Baseline study was completed in 1995. Groundwater sampling was conducted on a quarterly basis from November 1995 to February 1999. In 1999, the sampling frequency was reduced to trimester sampling (July 1999 and November 1999), and then to a semi-annual basis beginning in May 2000. Semiannual sampling (fall and spring) continued at the Site through 2004. In Status Report No. 26 issued in April 2005, it was recommended that semi-annual groundwater sampling be changed to annual groundwater sampling. Due to the slow migration of the contaminants through the Site, only one round of groundwater sampling was determined to be necessary each year to evaluate the effectiveness of the MOM. Groundwater sampling has been on an annual schedule for the previous five-years, with the fall being the target sampling season.

The first sampling round in this review period was the fall 2004 round which took place in January 2005. This was the first round that the sampling method was modified from utilizing bailers to the EPA Region I Low Stress (low flow) Purging and Sampling Procedure. Groundwater samples (a limited subset) were taken in November 2005. Six of the 23 monitoring wells were sampled for 1,4-dioxane to evaluate the levels of the compound in the northern and southern areas of the Site. A comprehensive sampling round took place in November 2006. Six monitoring wells were sampled for 1,4-dioxane to evaluate the levels of the compound in the central area of the Site. Twenty-nine of the monitoring well samples were also analyzed for natural attenuation parameters. The extraction wells were analyzed for VOCs, 1,4-dioxane,iron, and manganese. No groundwater samples were taken from monitoring or extraction wells in 2007 due to the transfer from USEPA to MassDEP. The most recent round of groundwater samples were collected in January 2009 and constitute the "Fall 2008" sampling round.

Approximately 120 groundwater monitoring wells are spread across the area of the Site. Additional wells have been installed (generally downgradient) during several investigation and remedial activities at the Site. Table 4 has a summary of groundwater samples taken during this review period.

Table 4 Summary of Groundwater Samples during this Five-Year Review Period

Sample Dates within FYR period	Number of MWs Sampled	Number of EWs Sampled	Summarized in Status Report No.
January 2005	58	22	26 (Watermark, 2005)
November 2005	23 (6 for 1,4-dioxane in north & south study areas)	22	28 (Watermark, 2006a)
November 2006	111 (6 for 1,4-dioxane in central study area)	22	30 (Watermark, 2007a)
January 2009	43	23	33 (Watermark, 2009)

Summary of Groundwater Results by Study Area:

North

The principal sensitive receptor in the North Study Area is indoor air at abutting (occupied) structures. The extraction well array is potentially ineffective at managing the migration of the plume from the Central to the North Study Area based on contaminant distribution and the hydrogeologic analyses. Four of the eight wells sampled in the North Study Area currently show increasing or potentially increasing trends in Total Volatile Organic as well as individual compound concentrations as documented in the Draft Status Report No. 33, excerpts provided below.

- The CZA indicates incomplete capture from the Central to the North Area in Portions of layers 1, 2 and 3.
- In the most recent SR, all but one monitoring well (MW-315A) currently show stable or declining trends in Total Volatile Organic (TVO) concentrations. MW- 315 has since been abandoned.
- MW-703A, MW-703C, MW-711B, MW-803-1-90 and MW-803-2-80 showed a potentially increasing TVO concentration; however, MW-703A appears to have stabilized in the latest SR .
- Over the last 5 years, MW-703C showed a potentially increasing trend of TVO, which has more recently stabilized.
- MW-501B and MW-703B showed a stable or decreasing TVO trend.
- Concentrations in excess of the Site's CUGs were measured in samples from several of the monitoring wells sampled.

It should be noted that the statements made by Watermark in their Status Reports (cited above and in subsequent sections) are based on a subjective qualitative evaluation of the chemical data over time, and do not reflect quantitative statistical treatment of the data sets. In some cases, for recently installed wells, there does not appear to be a sufficient number of data points to do statistical trend evaluations. Further sampling and evaluation will be required in order to determine statistical trends.

The type of soil in the north area may also be contributing to increased migration of contamination off-site. As the plume in Layer 2 moves to the north side of the site it first encounters varved clayey silt and then moves to fine sand or silt (see Figure 5). The hydraulic conductivity increases with the coarser material. Additionally the bedrock becomes shallower at the northern end of the Site. The combination of these two features of the Site may be causing the contamination migration rate to increase north of the site. Refer to Figure 5 for the detailed description of soil layers as well as the bedrock contour. The recent groundwater data supports that an increased migration rate may be occurring given that there is an increase in contamination concentrations in the northern area.

<u>South</u>

The principal sensitive receptor in the South Study Area is the indoor air quality in the residential properties. The MOM to this area is effective based on the existing pumping strategy.
The CZA shows complete capture from the Central to the South Area.
All but 1 monitoring well (MW-502A) are currently showing stable or declining trends in TVO concentrations. No CUGs were exceeded in samples from monitoring wells.

<u>East</u>

The principal sensitive receptor to the East Study Area is groundwater to surface water discharge to East Pond. The MOM to this area is effective based on the existing pumping strategy. The CZA indicates capture in all layers from the Central to the East Area. All monitoring wells show stable or declining trends in TVO concentrations except well MW-102A. CUGs were exceeded in one sample.

The historically low levels of contamination in wells near East Pond strongly suggest that the site contamination poses very little threat to East Pond. It is worth noting that East Pond is void of water through most of the year.

The TVO concentrations in the East area appear to be highest in layer 2 and diminish significantly as the groundwater goes deeper into layers 3 and 4. In general the extent of the East Area's TVO plume is slightly greater in the most recent Status Report.

West

The principal sensitive receptor in the West Study Area is groundwater to surface water discharge to River Meadow Brook.

The most recent 2006 CZA indicates that capture is present in all layers located in the western region of the Central Study Area in layers 1, 2 and 3. All monitoring wells sampled show stable or declining trends in TVO concentration. CUGs were exceeded in samples from 2 wells.

The historically low contaminant concentrations in the region of River Meadow Brook suggest that an insignificant quantity of contamination (levels below site CUGs) is reaching River Meadow Brook.

Central

The majority of wells showed stable or decreasing trends in TVO concentrations. Some wells show potentially increasing trends in TVO including MW-406B and MW-709A. Increases in concentrations in monitoring wells in the Central Area may be caused by the active pumping occurring at nearby extraction wells.

The TVO data shows mixed results for the monitoring wells located in layers 4 and 5. The contamination in layers 4 and 5 will be monitored in future sampling.

Figure 4 shows time series plots in TVO data over the past five-years for select wells. Data earlier than January 2005 was not included since the sampling method changed at that time from bailers to low-flow sampling and therefore the results would not be comparable. The wells were chosen to show concentration trends within the Central and North Study Areas at various depths. Wells MW-406B and MW-709A represent wells in the Central Study Area that have potentially increasing trends. In the case of MW-406B which is on the eastern side of the Central Study Area, wells further east do not exhibit increasing TVO concentrations. However wells MW-709A and MW-709B are in the northern area of the Central Study Area and wells further north, MW-803-1-90, MW-803-2-80, MW-803-3-70 and MW-703A show potentially increasing trends in TVO concentrations. Further monitoring of the MW-803 cluster is needed to determine a definitive trend since there are only two data points for these wells. Well MW-703C in layer 1 seems to have stable TVO concentrations. Table 5 shows a summary of individual VOC concentrations in selected wells and areas. The purpose is to give examples of the specific compounds, exceeding the CUGs, which are primarily contributing to the TVO concentrations. For example, even though MW-702B (located in the northern portion of the Central Area) shows a relative decrease in TVO concentrations, its highest TCE (170,000 µg/L) and PCE (15,000 µg/L) concentrations were recorded in the most recent sampling round.

Table 5. Summary of VOC Concentrations (μg/L) in Groundwater from selected wells during January 2005 to January 2009

Compound		1,4-Dioxane		Acetone		Benzene		Trichloroethene (TCE)		Tetrachloroethene (PCE)		1,1,1-Trichloroethane (TCA)	
Cleanup Goal		37,000		50000		480		1400		5000		50000	
Well Number	Study Area	Range	Most Recent	Range	Most Recent	Range	Most Recent	Range	Most Recent	Range	Most Recent	Range	Most Recent
MW-315 A	North	NS	NS	54000-83000	NS	3300-3700	NS	100 J-200U	NS	500 U-2000 U	NS	500 U-2000 U	NS
MW-408A	West	NS	NS	100 U-500U	250 U	2900-6900	2000	100 U-420 J	120 U	100 U-140 J	120 U	100 U-500 U	120 U
EW-04-C	Central	18	NS	5 U – 2500 U	8000 U	1600 J-13100	1200 J	62000-96000	49000	5200-6700	5600	54000-69000	58000
EW-06-C	Central	22	NS	5U -2000 U	10000 U	1200 J-1400 J	1300 J	45000 - 51000	40000	5500 - 7100	6300	42000-49000	45000
MW-101A	Central	NS	NS	8900 J	NS	5100	NS	93000	NS	9700	NS	42000	NS
MW-306A	Central	11000	NS	9800 J-36000	NS	1200 J-2400	NS	2000 U-16000	NS	930 J-2400	NS	2000 U-980	NS
MW-405 A	Central	540	NS	6100	NS	21000	NS	6200	NS	1700	NS	570 J	NS
MW-702B	Central	NS	NS	10000 J-58000 J	10000 J	2200 J - 10000 U	2200 J	56000 - 170000	170000	10000-15000	15000	21000	21000
MW-803-1-90	North	NS	NS	500 J - 170000	170000	250 J - 12000 U	12000 U	2 J – 12000 U	12000 U	1 J – 12000 U	12000 U	5 U – 12000 U	12000 U

Note: Green highlighted cells indicate exceedances of CUG.
NS = Not sampled

J = Estimated value less than the laboratory's reporting limit or based on data evaluation of laboratory results.

U = Compound was not detected above the laboratory's reporting limit. Reporting limits may be elevated due to sample dilution.

1,4-Dioxane

1,4-Dioxane has been added as a new COPC since the last FYR. It can be used as a historical marker for TCA and TCE contamination because it was added to drums of TCA and may have also been added to drums of TCE in order to prevent corrosion. It also would not have undergone any biodegradation, therefore it is unchanged. It is extremely soluble and would likely move to the outer edges of the contamination plume. Some may be in the original source area still due to the physical and chemical co-solvent properties of the complex mixtures. The recommended CUG for 1,4-dioxane in the Supplemental Clean-Up Goal Evaluation is 37 mg/L (Ttech, 2008). Table 5 shows the results of the limited 1,4-dioxane groundwater measurements.

Table 6 Results for 1,4-Dioxane in Monitoring Well Samples

Compound	Study Area	Sample Date	1,4-Dioxane Recommended CUG 37 mg/L
Monitoring Well Number			**Concentration or Concentration Range in µg/L**
MW-501B	North	Fall 2005	10U
MW-703A	North	Fall 2005	58J
MW-402B	South	Fall 2005	10U
MW-408A	West	Fall 2005	780J
MW-701B	Central	Fall 2005	22J
MW-702B	Central	Fall 2005 and 2006	6400-7000J
MW-713B	Central	Fall 2006	930 J
MW-716C	Central	Fall 2006	40U

U Compound not detected at reporting limit
J Estimated concentration above the method detection limit, but below the reporting limit

Monitored Natural Attenuation Parameters

Twenty-nine of the monitoring well samples collected in Fall 2006 were analyzed for natural attenuation parameters.
Natural attenuation parameters included alkalinity, chloride, nitrogen, sulfate, arsenic, manganese, methane, ethane, ethene, ferrous iron, total organic carbon (TOC), 1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene. The purpose of these analyses was to provide a baseline data set to be used for future evaluations of the natural attenuation capacity of the Silresim Site.

6.4.2 Soils

Currently the cap on the Silresim property and grading activities on the Lowell Iron and Steel property limit the usability of surface soil samples to evaluate current site conditions and changes that have occurred. It should be noted that most historic site activities took place on the Silresim property and the most significant VOC contamination source are located on the Silresim and Lowell Iron and Steel properties.

Soil boring data were collected from 1995 – 2007. Refer to Figure 6 for soil boring locations:

1995 Total of 21 shallow borings, typically two samples per boring at depths of 4 ft and 10 ft bgs (SB-21 through SB-40, and SV-2)
2001 Total of 23 borings, 3 to 5-ft sampling interval, typically to depths of 30 ft, with five locations extending to depths of 80 to 100 ft bgs (LIS-SB13 through LIS-SB19, and SIL-SB06 through SIL-SB21)
2007 Total of 37 shallow borings, typically three samples per boring, at depths of 2 ft, 6 ft and 8 ft bgs (LIS-A150 through LIS-D500)

In 2004, excavation, transport, and stockpiling of contaminated soil (from off Silresim property locations) was completed. Contaminated soil was transferred to the Silresim property, consolidated, and placed under a geosynthetic liner. A vegetative (grass) cover was established in May 2005. The volume of off-Silresim property soil excavated was 1,983 cubic yards. The excavation depth ranged from one to six feet below grade surface (in isolated "hot spot" areas).

Soil contamination was also evaluated as part of the ERH Evaluation (USACE, 2009). The revised soil CUGs in the 2008 ESD are protective against direct contact, but do not consider groundwater impacts (leaching of contaminated soil). However, the soil concentration Performance Goals developed for the enhanced SVE are designed to leave soil with sufficiently low levels of contamination that any leaching of contaminants from the soil should not lead to groundwater exceedances. The ERH Evaluation Report concluded that TCE and PCE are the primary clean-up drivers.

6.4.3 Surface Water

The historically low levels of contamination in wells near East Pond strongly suggest that the site contamination poses very little threat to East Pond. It is worth noting that East Pond is void of water through most of the year.

The historically low contaminant concentrations in the region of River Meadow Brook strongly suggest that an insignificant quantity of contamination (levels below site CUGs) is reaching River Meadow Brook (if at all). No surface water samples were collected within the five-year review period.

6.4.4 Indoor Air

Vapor Intrusion Evaluations were done at LIS and B&L Used Auto Parts. The LIS facility was evaluated first since it was located downgradient and was most directly at risk from the contaminated groundwater plume. The results of this evaluation are documented in the "Final Indoor Air/Vapor Intrusion Assessment for Silresim Superfund Site Lowell, Massachusetts" dated December 2004 (TtEC, 2004c). An evaluation of the B&L Used Auto Parts property is documented in a December 3, 2007 Memorandum.

In March 2007, EPA's Office of Site Remediation and Restoration (OSRR) developed a framework to assist in the evaluation of potential vapor intrusion issues at Superfund sites. The framework closely follows the EPA 2002 Draft Vapor Intrusion Guidance. Based on both the regional framework approach and the existing national guidance, EPA concluded that further assessment of the LI&S and B&L Used Auto Parts buildings to assess the potential for unacceptable indoor air concentrations as a result of contamination from the Silresim site is not warranted at this time. This conclusion was based on the following:

- The only buildings located within 100 feet of the Silresim VOC contaminated groundwater plume are the LI&S and B&L Used Auto Parts buildings;
- Indoor air sampling performed in the LI&S building concluded that detected concentrations of VOCs in indoor air appear to be at least partially attributable to commercial/industrial activities rather than solely to intrusion of vapors from contamination originating from the site. This information is summarized in the report prepared by Jacobs-Tetra Tech FW, "Indoor Air/Vapor Intrusion Assessment for the Silresim Superfund Site," October 2004; and
- An inspection performed on the B&L Used Auto Parts building and surrounding property concludes that automobile storage and service activities would impede the ability to collect representative soil gas and indoor air data. It was estimated that approximately 70-80% of the basement floor space was occupied by various stored automobile parts. Staining of the dirt and concrete floor was also observed and a strong petroleum odor was present.

Further assessment of the vapor intrusion pathway (VIP) was not recommended unless:

1. Concentrations and/or known toxicity of VOCs in shallow groundwater increase, or the shallow groundwater plume expands beyond the current extent;
2. New buildings are constructed over the plume, or within 100' of the plume; and/or
3. Future uses of the LI&S or B&L Used Auto Parts properties change to include non-industrial uses, particularly for residential purposes.

A property use assessment at LIS was documented by EPA in a memo dated April 14, 2008. This assessment was a follow-up to the 2007 Memorandum and the resulting conclusions listed above. The property use assessment concluded that based on the continued lack of utilization of basements as well as the various industrial operations conducted, the vapor intrusion pathway is not considered complete at any of the LIS properties.

The 2008 ESD acknowledges, in accordance with 2002 Vapor Intrusion Guidance, that under the present uses of abutting properties (including the Scannell Boiler Works building located at 44 Tanner Street), that a complete VI pathway does not exist. The ESD also recommended periodic (annual) assessment of abutting properties to ensure that uses have not changed and that there are no new receptors (such as residents, etc…)

6.5 Site Inspection

A site inspection was conducted on November 25, 2008. The inspection included a site walkover, inspection of monitoring and extraction wells both within and outside the Site fence, and a walkthrough of the existing GWTP. A Site Inspection Report is included in Appendix C. The Site is secured by a chain-link fence surrounding the entire Silresim property. The Site wells are secured with locks and protective devices. No incidents of vandalism have occurred, however there were a few cases of monitoring well damage resulting from inadvertent truck and/or equipment contact. The Site is occupied and monitored daily by personnel from Watermark Environmental, the current O&M Contractor. A full site inspection is also periodically performed as part of each annual groundwater monitoring event.

6.6 Local Interviews

As required in the EPA Five-Year Review Guidance Document, interviews were conducted with representatives of the MassDEP and the City of Lowell. Interviews conducted as part of this Five-year review are in Appendix A.

Generally, based on the results of the interviews conducted, implementation of the selected remedy has proceeded without significant issues or concerns.

6.7 Institutional Controls

Institutional Controls at the Site are in the form of Easements obtained in 1995 for the Boston and Maine Rail Yard, Maple Street Business Exchange Condo Trust and Mill City Investments, Inc., Tucci property, and Lowell Iron and Steel. The Easements grant EPA access in, over, under, across, upon and through the areas on adjacent property designated as the groundwater monitoring area, the groundwater extraction area, the soil vapor extraction area and the permanent Cap Area. Access via roads and driveways to these areas is also specified in the easements.

The grantors (property owners) retain rights including access to and use of the surface and subsurface in any manner that does not prevent, disrupt or otherwise interfere with the activities described in the agreements and as long as it does not interfere with the reconstruction, use, alteration, maintenance, repair or replacement of any groundwater monitoring well or damage any groundwater monitoring well. The easement also states that no specific action by the Grantor shall be permitted that interferes with the integrity of any of the wells. There may be a violation of these conditions in the grants and easements since three monitoring wells were damaged by others in 2008. The three wells were all in the East Study Area (MW-106B, MW-410A and MW-410B). In light of the additional remedial action (RA), and based on the monitoring reports, it is not clear if these wells need to be repaired or properly decommissioned. This determination will be made post ERH treatment. See photos below.

Photo 1 MW-106B

Photo 2 MW-410A

Photo 3 MW-410B

7.0 TECHNICAL ASSESSMENT

This section summarizes the technical assessment of the Site by evaluating the effectiveness of the remedy, the applicability of the criteria that support the remedy, and the protectiveness of the remedy.

7.1 Technical Assessment Questions

This section addresses the three technical assessment questions identified in the EPA's Five-Year Review guidance document as noted below:

Question A: *Is the remedy functioning as intended by the decision documents?*

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?*

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

The following discussion details how each question has been answered based on the findings of this five-year review.

Question A: Is the remedy functioning as intended by the decision documents?

Yes. The GWTP continues to operate at a very high level of efficiency relative to contaminant removal and runtime. The proactive operation and maintenance of the GWTP has allowed operation runtime to be maximized at 97.6% of available runtime in the most recent summary period (September 1, 2008-February 5, 2009). Previous review periods within the last five years also show a similarly high percentage rate for runtime. A total of 4.140 million gallons of contaminated groundwater were pumped and treated through the system between September 1, 2008 and February 5, 2009. It is estimated that the GWTP removed approximately 1.68 tons Total Toxic Organics (TTO) (2.09 tons Total Volatile Organics (TVO)) of contamination from the Site during this period. TTO is a sum of total volatile toxic organics (TVTO) and other toxic organics including semi-volatile organic compounds, pesticides and PCBs. TVO is a sum of TVTO and other VOCs not considered toxic like acetone. TVTO and TTO are established by the USEPA and adopted by the LRWU. The total estimated mass removed by the GWTP to date is approximately 86.79 tons TTO (104.33 tons TVO) since it began operations in November 1995.

The GWTP operated in compliance with all effluent discharge regulations and air emission guidelines through this operation period as well as all operation periods within the five-year review period. The GWTP discharge permit criteria are based on TTO and are currently set at 2.13 ppm TTO. The toxicity of the discharged water cannot interfere with the biodegradation processes at the LRWU plant. The influent and effluent water is sampled monthly to test for discharge permit compliance sampling for VOCs. The GWTP influent contaminant conditions are a function of the extraction wells that are in operation at the time of sampling. The system effectively removed VOC contamination from the influent during the five-year review period, with the average discharge concentration in the most recent period (September 1, 2008 – February 5, 2009) of approximately 0.21 ppm TTO. Acetone continues to be present in the influent in high concentrations. Given that acetone is a biodegradable compound the LRWU has accepted acetone in the GWTP discharge.

Other analytes are sampled within the plant to assess treatment equipment performance. These include metals, pH, total dissolved solids (TDS) and total suspended solids (TSS). In addition the thermal Oxidizer (TOX) emissions are sampled bimonthly. This testing includes MassDEP Waste Site Cleanup, Policy # WS-94-150, Off-Gas Treatment of Point Source Remedial Air Emissions testing for vapor contaminant Destruction Removal Efficiency (DRE). These results have been satisfactory for this review period.

Modifications have been made to the MOM extraction and monitoring wells within the last five years to improve efficiency. This includes the addition of 11 monitoring wells and the decommissioning of 21 monitoring wells between February and October 2007. Several wells were replaced in the fall of 2006 and they are documented in Status Report No. 30. These were installed to replace one existing well cluster (MW-315) and one destroyed well (MW-701C) and to fill identified data gaps in the on-going evaluation of the MOM system as recommended in the previous Status Report, No. 29. Well clusters MW-803, MW-804, MW-805 and MW-806 were installed within layers 1-4. The monitoring wells that were decommissioned were abandoned per the Mass DEP guidance documents for decommissioning of monitoring wells (MassDEP, 1991 and MassDEP, 1999).

Review of Status Reports and other site documents and the groundwater monitoring data indicate that the remedy components that have been completed are functioning as intended by the ROD and the ESDs issued in 2003 and 2008. However the MOM remedy will not meet the RAOs within the targeted timeframe. The GWTP continues to remove significant quantities of VOCS. Despite the mass removal via pump and treat technology, the plume remains relatively widespread. The CZA showed incomplete capture from the Central to the North Area in layers 1, 2 and 3.

There seems to be an increasing trend in contamination in groundwater leaving the Site in the North Area. Refer to Figure 4 in Appendix D for recent trends of TVO contamination in the Central Study Area and in the new monitoring wells in the North Study Area. The increase in contamination concentration in the most recent sampling round is cause for concern. The increases in concentrations are being monitored closely with additional groundwater sampling scheduled.

Based on a report entitled "Evaluation of Future Groundwater Flushing (March 2004)," it was anticipated that attainment of groundwater CUGs utilizing pump and treat technology alone may take several hundred years. Tetra Tech FW, Inc. (TT FW, formerly Foster Wheeler Environmental Corporation [FWENC]) (Tetra Tech, 2004) originally developed and ran the flushing model for various scenarios to evaluate the relative impacts of thermal treatment on clean-up times (time required for groundwater to reach CUGs).

A more aggressive source control remedy than the original SVE is necessary to shorten the length of time needed to reach acceptable CUGs. Thermally-enhanced SVE, ERH, will substantially reduce the treatment time. This has been demonstrated in a Final Technical Memorandum Treatment Zone Evaluation (USACE, 2009). In the evaluation the clean-up times were calculated for TCE and PCE in the first three layers. See Figure 5 showing a cross section of the site and the numbered layers. Figure 6 shows the Core Areas discussed in the evaluation.

The primary objective of this remedial approach is to reduce the duration of long-term groundwater extraction activities at the site by reducing concentrations of VOCs in both soil and groundwater. Complete clean-up of the entire site was not envisioned, and it is understood that contamination will remain after treatment. The ideal treatment zone will result in a significantly reduced duration required for groundwater extraction, the benefit of which would offset the relatively high cost of a thermal-enhanced treatment remedy.

The flushing model was re-run in order to test the relative effects of various treatment zone limits on clean-up times, and for comparison purposes model parameters and hydraulic assumptions were kept identical to the previous model by FW TT. The durations predicted by the flushing model should not be applied as absolute values, but should be treated as a range in limits, and can provide insights strictly in relative terms.

For Alternative 1, Core Areas A through E, TCE clean-up times reduce from a maximum of 636 years to 596 years. This duration is driven primarily by the remaining contamination at the MW-404 well cluster (southern portion of the site) and at MW-702B (north of the site). By including these areas (F and G) in the treatment zones for Alternative 2, Core plus Areas F and G, there will be no remaining exceedances for Layer 2 post-treatment, and the Layer 1 clean-up time is reduced from 96 years (no treatment) to 61 years (36% reduction). Both alternatives show a reduction in duration for Layer 3, from 508 years (no treatment) to 311 years with treatment (39%). PCE timeframes are all significantly shorter than those for TCE.

If the proposed in-situ thermal remediation treatment is implemented, the extraction well network will need to be redesigned in order to optimize capture of the remaining plume, whether just in the uppermost three layers or to also include the deeper layers. Historically, one of the issues at the site has been very poor well yield, which has been attributed to the low hydraulic conductivity of site materials having high silt content. Extraction wells to date have been installed using channel-pack wire-wrapped screens, where the filter sand is contained between an inner and outer wire-wrap screen, rather than placed solely in the annular space between the borehole wall and the screen. Based on experience at another groundwater extraction well network installed at a site with similar fine-grained materials, the well installed using the channel-pack screen had a far lower well yield compared to the conventional wells installed in boreholes drilled using reverse circulation methods.

The other components of the remedy, institutional controls and the soil cap, are functioning as originally intended. However updated institutional controls may need to be implemented to reflect current land use and ownership. CUGs were revised due to the reclassification of groundwater at the site as non-potable.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

No. The ROD cleanup levels were updated twice. The most recent CUG update recommendations are calculated and presented in the Supplemental Clean-up Goal Evaluation Technical Memo dated May 2008 (TtEC, 2008). Both the 2003 and 2008 ESDs adopt the most current CUGs based on the most current toxicity data and exposure assumptions. Refer to Tables 1-3 in Appendix B for current CUGs and Table 3 in Section 6.3.3 for changes in toxicity values since May 2008. The updated toxicity values used to calculate the 2008 CUGs are presented in table 4 of Appendix B.

The 2003 ESD predominantly amended groundwater and soil Clean-Up Goals (CUGs) based on changes in chemical toxicity information as well as a Groundwater Use & Value determination prepared by the MassDEP. The determination was for low use and low value designation for the groundwater underlying and adjacent to the Site (MassDEP, 1998).

A second ESD was issued in September 2008 which adopted further updates to CUGs and redefined the selected source control remedy as thermally-enhanced SVE to better deal with the tight soils and the water content within the soils. Based on a 2007 correspondence from the City of Lowell regarding the potential future uses of the site and updated toxicological data, CUGs were recalculated. These revised CUGs are now formally incorporated into the current clean-up goals for the Site. The ESD tables in Appendix B have been highlighted to reflect changes in the CUGs. The previous CUGs (in the 2003 ESD) were based in part on exposure pathways that have either been eliminated or are not complete. Specifically, the City of Lowell envisions this property will be reused for commercial/industrial purposes and is no longer considering recreational reuse for this property. Other changes in the development of CUGs include the elimination of a railroad worker's exposure as this potential exposure is similar to exposure of a construction or utility worker. Lastly, based on indoor air sampling at an abutting property (LIS) as well as observations as part of a recent property use assessment (2008), the indoor air migration pathway is currently considered incomplete, but will continue to be monitored. EPA observed that various chemicals and/or solvents are used routinely, as part of business operations at B&L Used Auto Parts facility. The presence of these industrial solvents prevents the accurate assessment of risk posed by similar chemicals in a groundwater plume.

The 2008 revised CUGs presented in Appendix B are protective of utility, construction, industrial/commercial workers, and trespassers. These CUGs are presented in Appendix B as Table 1 (Surface Soil), Table 2 (Subsurface Soil) and Table 3 (Groundwater). The revised CUGs vary compared to the 2003 ESD clean-up levels because, despite eliminating some exposure pathways (i.e., indoor air migration), there were changes in a number of toxicological values for certain contaminants of potential concern. Therefore, some of the revised CUGs in 2008 are more stringent and some are less stringent than before. These CUGs are highlighted to show the changes in Tables 1-3 in Appendix B.

The 2008 Supplemental CUG Evaluation includes COPCs that have been added to the Site based on data and information since the ROD. This includes 1,4-dioxane. The vapor intrusion pathway evaluation has been added as an exposure pathway to be monitored.

<u>Question C: Has any other information come to light that could call into question the protectiveness of the remedy?</u>

Yes, as listed below. There is currently no complete exposure pathway for groundwater, contaminated soils, or air. Although for this to remain true the following need to be evaluated:

1. The extent of groundwater capture especially to the North. The contamination in layers 4 through 6 could be re-evaluated since both the groundwater extraction system and the thermal remedy focus on only the uppermost three layers. It is essential that any potential off-property preferential pathways (such as the sewer line) and receptors are identified and evaluated, to assess and assure long-term future protectiveness.
2. Land use and institutional controls need to be maintained and updated if necessary.

7.2 Summary of the Technical Assessment

Review of Status Reports and other site documents and the groundwater monitoring data, indicate that the remedy components that have been completed are functioning as intended by the ROD and the ESDs issued in 2003 and 2008. However the MOM portion of the remedy will not meet the RAOs within a reasonable time (30 years). The GWTP continues to remove significant quantities of VOCS. Despite the mass removal via pump and treat technology, the plume remains relatively widespread. The most recent capture zone analysis (CZA) showed incomplete capture from the Central Study Area to the North Study Area in layers 1, 2 and 3. The concentrations should be monitored closely and will be verified before the next scheduled routine monitoring event.

A more aggressive source control remedy than the original SVE is necessary to shorten the length of time needed to reach CUGs. Thermally enhanced SVE, ERH, will substantially reduce the treatment time. This has been demonstrated in a Final Technical Memorandum Treatment Zone Evaluation (USACE, 2009). If the proposed in-situ thermal remediation treatment is implemented, the extraction well network will most likely need to be re-evaluated (post treatment). The other components of the remedy; institutional controls and the soil cap, are functioning as originally intended. However, updated institutional controls may need to be implemented to reflect current land use and ownership. The cap design has been approved and should be constructed and maintained.

8.0 ISSUES

This Five-Year Review has identified several issues listed in Table 7.

Table 7. Issues at the Silresim Superfund Site, City of Lowell, Commonwealth of Massachusetts.

Issues	Affects Current Protectiveness	Affects Future Protectiveness
The sewer line trench may serve as a preferential pathway for contaminated groundwater.	No	Yes
Increasing contaminant trends in some monitoring wells in the North Study Area suggest that the pumping strategy may be potentially ineffective in managing plume migration.	No	Yes
Institutional Controls need to be kept updated and need to consider VOC and non-VOC contamination now and after any planned remediation treatment.	No	Yes
Vapor intrusion is a potential concern in areas north of the site; however, provided property use and zoning remain the same (re: industrial), this remains an incomplete exposure pathway	No	Yes

9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

In response to the issues noted above, recommended actions are listed in Table 8:

Table 8. Recommendations and Follow-up Actions for the Silresim Superfund Site, City of Lowell, Commonwealth of Massachusetts.

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness	
					Current	Future
The sewer line trench may serve as a preferential pathway for contaminated groundwater.	Check on depth of trench and pipeline and compare (in the same datum) to the groundwater contamination coming from the Site.	MassDEP	USEPA	Sept 2011	No	Yes
Increasing contaminant trends in some monitoring wells in the North Study Area	Increase frequency of data collection to verify recent results and evaluate post thermal treatment, the need for additional extraction and monitoring wells.	MassDEP	USEPA	Sept 2011	No	Yes
Institutional Controls need to be kept updated	In order to ensure long-term protectiveness, the existing IC should be re-evaluated post-ERH treatment and amended as necessary	MassDEP and USEPA	USEPA	Sept 2014	No	Yes
Vapor intrusion is a potential concern in areas north of the site.	Continue periodic assessments of abutting property uses, zoning, and groundwater monitoring data as they relate to the potential for vapor intrusion into indoor air.	MassDEP	USEPA	Sept 2014	No	Yes

10.0 PROTECTIVENESS STATEMENT

All immediate threats at and from the Site have been addressed. The comprehensive remedy is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Long term protectiveness of the remedial action will be verified by continuing the ongoing groundwater monitoring program, both on the Silresim property and in downgradient areas. Portions of the plume may have migrated beyond the extraction well array to the North Study area, and are being closely monitored. Current monitoring data indicate that the plume is contained in the other three study areas.

In order for the remedy to be protective in the long-term, the following actions need to be taken:

- It is essential that any potential off- property migration pathways and receptors are identified and evaluated, to assess and assure long-term future protectiveness.
- Update Institutional Controls, as necessary pending the successful complete of additional Source Control remediation (ERH)
- Periodic (Annual) evaluation of property usage at abutting properties to ensure that no new construction, uses or zoning changes have occurred.
- The final cap design has been completed and now needs to be implemented.

11.0 NEXT REVIEW

The next five-year review should be completed by September 30, 2014. The next review should include a complete review of data generated under the long-term monitoring program to determine if contaminant concentration trends are consistent with those projected in the ROD. The next review should also include an evaluation of any improvements to site access control features and the effectiveness of institutional controls for the Site once they are finalized.

12.0 References

City Manager of Lowell, 2007. Draft Tanner Street Initiative Silresim Superfund Site Conceptual Future Use and Cap Design Input Letter to EPA. June.

Foster Wheeler, 2002. Final Additional Site Investigation and Revision of Site Cleanup Goals, Silresim Superfund Site, Lowell, Massachusetts. January.

Jacobs-Tetra Tech FW Joint Venture, 2004. Indoor Air/Vapor Intrusion Assessment for Silresim Superfund Site, Lowell, Massachusetts. October.

Mass DEP, 1991. Standard References for Monitoring Wells, Section 4.6-Decommisssioning Monitoring Wells, Massachusetts Department of Environmental Protection. January.

Mass DEP, 1998. Groundwater Use and Value Determination Silresim Superfund Site. October.

Mass DEP, 1999. Standard References for Monitoring Wells, Section 4.6-Decommissioning Monitoring Wells (Revised), Massachusetts Department of Environmental Protection. January.

Mass DEP, 2002. Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of the MADEP VPH/EPH Approach. October 31.

Mass DEP, 2003. Groundwater Use and Value Determination Letter to EPA. May 8.

Mass DEP, 2003. Final Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology. November.

Mass DEP, 2007. Silresim ERH Final Letter to EPA. June 15.

Tetra Tech FW, Inc. (TtEC), 2004a. Evaluation of Future Groundwater Flushing, Silresim Superfund Site, Lowell, MA. March.

TtEC, 2004b. Five-Year Review Report for Silresim Superfund Site, City of Lowell, Middlesex County, Massachusetts. September.

TtEC, 2004c. Final Indoor Air/Vapor Intrusion Assessment for Silresim Superfund Site Lowell, Massachusetts. December.

TtEC, 2007. Final Cap Evaluation Report Technical Memorandum, Silresim Superfund Site, Lowell, Massachusetts. November.

TtEC, 2008. Technical Memorandum Supplemental Clean-Up Goal Evaluation, Silresim Superfund Site, Lowell, Massachusetts. May 5.

USACE, 2009. Final Technical Memorandum Treatment Zone Evaluation for Silresim Superfund Site Lowell, Massachusetts. April 19.

USEPA, 1991. Record of Decision Summary, Silresim Superfund Site, Lowell, Massachusetts. September.

USEPA, 1997. Health Effects Assessment Summary Tables (HEAST). EPA-540-R-97-036. July.

USEPA, 2001. Comprehensive Five-Year Review Guidance. EPA-540-R-01-007, prepared by the Office of Emergency and Remedial Response (5204G), USEPA, Washington DC, June 2001.

USEPA, 2004. Five-Year Review Report for Silresim Superfund Site City of Lowell Middlesex County, Massachusetts. September 9.

USEPA, 2005. Interim Remedial Action Report Source Removal Operable Unit II Surficial Soils, Silresim Superfund Site, Lowell, Massachusetts. September 21.

USEPA, 2007a. News Release "EPA Proposes Changes to the Silresim Chemical Corporation Clean-up Plan and Opens Public Comment". July 28.

USEPA, 2007b. Assessment of the Vapor Intrusion Pathway and Related Inspection of B&L Used Auto Parts – Silresim Superfund Site, Lowell, MA. December 3.

USEPA, 2008. Explanation of Significant Differences for the Silresim Chemical Corporation Superfund Site Lowell, Massachusetts. September.

USEPA, 2009. Memorandum: Interim Recommended TCE Toxicity values to Assess Human Health Risk and Recommendations for the Vapor Intrusion Pathway Analysis. January 15.

Watermark Environmental, Inc., 2004. Status Report No. 23 February 6, 2003 – August 5, 2003 Silresim Superfund Site Lowell, MA. February.

Watermark Environmental, Inc., 2005. Status Report No. 26 August 6, 2004 – February 5, 2005 Silresim Superfund Site Lowell, MA. April.

Watermark Environmental, Inc., 2006a. Status Report No. 28 August 6, 2005 – February 5, 2006 Silresim Superfund Site Lowell, MA. September.

Watermark Environmental, Inc., 2006b. Status Report No. 29 February 6, 2006 – August 5, 2006 Silresim Superfund Site Lowell, MA. September.

Watermark Environmental, Inc., 2007a. Status Report No. 30 August 6, 2006 – February 5, 2007 Silresim Superfund Site Lowell, MA. August.

Watermark Environmental, Inc., 2007b. Status Report No. 31 February 6, 2007 – September 24, 2007 Silresim Superfund Site Lowell, MA. November.

Watermark Environmental, Inc., 2007c. Tanner Street Initiative Silresim Superfund Site Innovative Storm water Project, Lowell, MA. November.

Watermark Environmental, Inc., 2008. Status Report No. 32 September 25, 2007 – August 31, 2008, Silresim Superfund Site Lowell, MA. December.

Watermark Environmental, Inc., 2009. Draft Status Report No. 33 September 1, 2008 – February 5, 2009, Silresim Superfund Site Lowell, MA. March.

APPENDIX A - INTERVIEW DOCUMENTATION

INTERVIEW DOCUMENTATION FORM

The following is a list of individual interviewed for this five-year review. See the attached contact record(s) for a detailed summary of the interviews.

Name	Title/Position	Organization	Date
Janet Waldron	Project Manager	Massachusetts DEP	1-16-09
Name	**Title/Position**	**Organization**	**Date**
John Haley	Project Manager	Watermark Environmental, Inc.	2-10-09
Name	**Title/Position**	**Organization**	**Date**
Mike Stuer	Manager	Lowell Regional Wastewater Utility (LRWU)	2-24-09

INTERVIEW RECORD 1

Site Name: **Silresim Superfund Site**	EPA ID No.: **MAD000192393**	
Subject: Third Five-Year Review	Time: 1523	Date: 1-16-09
Type: Telephone . Visit X Other : Email	Incoming . Outgoing	

CONTACT MADE BY

Name: Katherine Malinowski	Title: Chemist	Organization: USACE

INDIVIDUAL CONTACTED:

Name: Janet Waldron	Title: Project Manager	Organization: Mass DEP
Telephone No: 617-556-1156 Fax No: E-Mail Address: Janet.Waldron@state.ma.us	Street Address: One Winter Street City, State, Zip: Boston, MA 02108	

SUMMARY OF CONVERSATION

Q1: What is your overall impression of the project and site?

A1: The MassDEP believes that under current operations the remedy is protective of human health and the environment. We are concerned, however, that there is no "exit strategy" for the Site that would allow us to make the decision to cease operations at the Site (or limit operations) if it is determined that cleanup goals will never be reached (or not reached in a reasonable period of time). The current estimate (without further remedial action/source removal or reduction) is that the plant will have to operate for over 500 years before achieving cleanup goals throughout the aquifer.

Q2: Are you aware of any issues the five-year review should focus on?

A2: This may be out of the scope of a five-year review, but one thing that would be very helpful would be an evaluation of how changes in operation of the groundwater treatment plant might affect the plume, such as pulsing the system, shutting it down completely, or operating extraction wells only in the source area on the Silresim property. That is, would the remedy still be protective if a portion of the plume was allowed to "escape" the extraction system (the downgradient portion that may be at or near cleanup goals).

Q3: Who should USACE speak to in the community to solicit local input?

A3: Names and contact information were provided at the November 2008 site meeting.

Q4: Is the remedy functioning as expected?

A4: The remedy is functioning as designed and built, however, during the RI/FS process, there was no projection of how long the remediation (groundwater cleanup) would really take. At the time, the expectation was probably 30 years (seemingly to be the "default" time period for a lot of pump & treat systems in the late 80's early 90's). Also, the soil vapor extraction that was called for in the ROD was not successful due to the lack of knowledge of the site conditions (very tight soils with an extensive capillary fringe making soil vapor extraction essentially useless).

Q5: Is the City actively involved in the site or do they show an active interest?

A5: The City has not showed much interest recently. There had been an active community group at the time the Remedial Investigation was occurring and for the first few years of remedy implementation. It appears that now that the community knows that things are "under control" they are not as concerned (or at least is comfortable with the job the government is doing).

Q6: Have there been any changes in the site or surrounding property in the last 5 years, or are changes planned?

A6: One adjacent property (Lowell Iron & Steel) continues to use portions of their property for truck trailer storage, which at times has caused difficulties for the government to conduct remedial activities (such as soil investigation and groundwater monitoring). One nearby property is being evaluated for the potential of an energy facility that might bring more activity nearby with the potential for more difficulties with conducting groundwater monitoring (accessing wells when needed).

INTERVIEW RECORD 2			
Site Name: **Silresim Superfund Site**		EPA ID No.**: MAD000192393**	
Subject: Third Five-Year Review		Time: 1400	Date: 2-10-09
Type: X Telephone . Visit . Other :		Incoming . Outgoing	

CONTACT MADE BY		
Name: Katherine Malinowski	Title: Chemist	Organization: USACE

INDIVIDUAL CONTACTED:		
Name: John Haley	Title: Project Manager	Organization: Watermark Environmental, Inc.
Telephone No: (978)-452-9696 Fax No: (978)-453-9988 E-Mail Address: johnh@watermarkenv.com	Street Address: 175 Cabot Street City, State, Zip: Lowell, MA 01854	

SUMMARY OF CONVERSATION

Q1. Since there is no SIC Code for remedial treatment of groundwater, what SIC Code was used to come up with the effluent concentration goal (2.13 ppm)? The original permit issued by the LRWU assigned the SIC Code for metal finishing.

Why was this code chosen? It was chosen by the LRWU based on the fact that a lot of the waste at the site was from metal finishing.

On page 2-2- in Status Report 32 it reports the “monthly” influent/effluent sampling. Is the 2.13 ppm limit a monthly average? If not, what is it?

It is the limit for the permit required samples that are taken twice a year. Since the Lowell Regional Wastewater Utility (LRWU) does not have a TTO limit in the permit, what will happen (if anything) if the ‘self-imposed’ 2.13 ppm limit is exceeded? Nothing, There would not be any immediate reaction. The concentration has never exceeded the 2.13 ppm limit. If it ever did it would be addressed with the LRWU at that time.

For example if more optimization of the GWTP happens (still considering removing the boiler?). This may cause an increase in effluent concentrations. There is a low tray stripper from Norwood, which they are considering incorporating after the tower air stripper. Watermark did some preliminary feasibility calculations to determine if adding the second stripper and turning off the boiler would work. Based on the results it is believed this would work and the GWTP effluent would still be below the 2.13 ppm limit. The purpose of turning off the boiler is to save the cost of natural gas used to fuel the process boiler.

Q2. We reviewed the Risk Assessment (RA) in SR 31 (Appendix F). Dan said it was mutually agreed upon that the scenarios were not realistic and overly conservative. Who should I talk to about actual city worker manhole exposures (frequency that they access, PPE used etc.)? Mike Stuer. Twice a year the site staff cleans out the manholes and piping (before Tanner Street) from outside the manholes. Since they are a municipality they do not fall under OSHA requirements.

Dan also mentioned a memo about the decision about the RA, do you have this memo?
John said he would send a copy of the meeting minutes relative to the sewer discharge permit risk analysis. He discussed how the initial RA was not realistic and overly conservative. It was done using the influent concentrations only to be overly conservative. He said using the effluent concentrations would be too complicated since many compounds are reported in the TTO (total toxic organic) concentration. There would be too many compounds with different toxicities to determine a TTO concentration that meets an acceptable risk number.

John added, "I mentioned that the Risk Assessment was completed to try and increase the discharge limit thereby potentially reducing operating costs. The assessment was never intend(ed) to document actual sewer worker exposure. It was performed to try and find the basis for a number based on actual site discharge concentrations."

Q3. Since 1,4 – dioxane has been added to the list of COCs for the site, will it also be added to the influent and effluent analysis lists? (Not currently listed in Tables B-1 and B-2 of SR 32). This would only be added to the permit by the city. The list of compounds is derived from EPA discharge permit requirement for discharge to the Merrimack River.

Q4. During the site visit there was a discussion about some initiatives within the last 5 years, such as separating the sewer system and surface water and infrastructure improvements etc. In the notes it says John H. will send a PDF about some plans. Do you have this PDF?   John said he will send a copy of the Tanner Street Initiative Design Report.

Q5. Some of us noticed a strong (bitter, dank) odor especially near the air stripper. Therefore, may be the air stripper is leaking, or the air capturing system off the treatment equipment may not be working properly? The odor is from the MRS (metals removal system) because the tank is not completely sealed. The HVAC system may pull down the fumes to the ground. They are exhausted at the floor. This may be why the odor is apparent near the air stripper although it is from the MRS.

We also noticed that some people could not smell the odor (Ian) and therefore it may be that some workers in the plant do not notice the smell, but potentially are still being exposed to whatever is causing it.

John explained, "The GWTP has an odor troubleshooting procedure which when followed by site staff will eliminate 99% of the odors periodically experienced in the GWTP. These odors come from various plant conditions and operating scenarios, which are identified when the procedure is followed. Step 1 of the procedure is to verify with an FID there is no Health & Safety exposure."

Q6. During a discussion last week with Dan he mentioned that he heard about damaged monitoring wells on abutting properties and that letters were sent to the owner(s) since this is a not allowed under the easement agreements. Which monitoring wells were damaged and did it take place within the last five years? Was this resolved with the abutters? Do those monitoring wells need to be replaced? He will email a list and photos of the damaged monitoring wells (MWs). They were discovered during the last round of groundwater sampling near property where new power plant is supposed to go in.

The EPA and DEP had discussions about the damaged monitoring wells at the time they were discovered. They discussed if the easements were enforceable enough to get the abutters to pay for the repair/replacement of the wells. This is ongoing.

Q7. What is your overall impression of the project and site? The plant is running well. The biggest issue in his opinion is what will be the acceptable cleanup level for the site? There are clean-up goals (CUGs) but these are not realistic to reach, even if electrical resistive heating (ERH) is utilized. He believes this will only change the time to achieve CUGs from 500 years to 250 years and this is not good enough. What are the specific and realistic long-term cleanup goals for the site? What is the next step to deciding what the acceptable level is going to be? He believes that after ERH discussions will turn to this issue again. Risk analyses and engineering evaluations can be done by contractors, but ultimately the regulators have to decide what it (the realistic goal) is and then we (the contractors) can tell them how to get there.

Q8. Is the city actively involved in the site or do they show an active interest? There is very limited interest. He has been interacting w/people in the area for so long, that there is some level of comfort. If anyone expresses concern at a public meeting it is usually about the aesthetics of the site and surrounding properties, not the contamination.

Q9. Have there been any changes in the site or surrounding property in the last 5 years, or are changes planned? Just the proposed power plant on the land near the railroad tracks (also the location of the damaged monitoring wells).

INTERVIEW RECORD 3

Site Name: **Silresim Superfund Site**	EPA ID No.**: MAD000192393**	
Subject: Third Five-Year Review	Time: 1610	Date: 2-24-09
Type: X Telephone . Visit . Other :	Incoming . Outgoing	

CONTACT MADE BY		
Name: Katherine Malinowski	Title: Chemist	Organization: USACE

INDIVIDUAL CONTACTED:		
Name: Mike Stuer	Title: Manager	Organization: Lowell Regional Wastewater Utility (LRWU)
Telephone No: 978-970-4248	Street Address: 815 Pawtucket Blvd. City, State, Zip: Lowell, MA 01854	

SUMMARY OF CONVERSATION

Q1: What is your overall impression of the project and site?

A1: He has been working with John Haley and Watermark for 10 years of O&M at the Site. He has a high opinion of Watermark and John Haley.

Q2: Do you have any comments, suggestions or recommendations regarding the Site's management?

A2: He thinks they are doing a good job running the plant and it is a well run operation. The raw and treated groundwater that goes to the sewer doesn't create a large risk to the neighbors. There is potential risk to the abutters, but nothing alarming. His concern is not with the entities that have permits, but with those that aren't permitted. It's unknown what the ones that don't have permits are dumping.

Q3: Has the Site been in compliance with permitting and reporting requirements (TTO of 2.13 ppm)?

A3: Yes, always excellent. There is not an actual TTO requirement. The permit is based on 40 CFR 433 (electroplating). If the Silresim GWTP was ever over the limit we would negotiate – it's a self regulating. It's more of a guideline than a limit. They (the GWTP) are doing a good job discharging only a low level of organics. They never have a problem with metals. They have to watch TTO.

Q4: What is the frequency that a city worker performs work inside manholes, for example the manholes on Tanner Street?

A4: Do not work on manholes frequently – only cleaning out catch basins 1/year or every other. The work usually involves a vacuum truck with a hose. The workers do not enter the manholes to do this cleaning.

Q5: What is the protocol for workers performing work in manholes? What kind of PPE do they wear?
A5: Gas meter to test air. Level C. Twice a year is a reasonable assumption.

Q6: Have there been any changes in the site or surrounding property in the last 5 years, or are changes planned?

A6: A large drainage system was put south of the Site by ~ 500'. Canada Street (on Tanner Street) is as far north as they went. The drainage system empties into Meadow Brook to help with drainage separation of combined sewer. The Drainage system from the Site to Meadow Brook is original. There are no plans to work on it right now. The run-off foes through vortex and into Meadow Brook.

Making improvements, building infrastructure – needs to be part of urban renewal. They are interested in this, but not able to do it independently. For example, Tanner Street road condition is in bad shape and that is a big factor to not extend the drainage system further north. It is in really bad shape. It needs re-grading, sidewalks. LRWU would be happy to participate in plans.

The sewer goes right down Tanner Street; it's a 52"X38" oval brick sewer. They spent $ 100,000. cleaning up the sewer when they needed to put additional flow through it in 2008 through the main trunk line from Chelmsford. It was cleaned and it was successful.

Q7: Is 1,4-dioxane on the list of compounds regulated for the discharge permit?

A7: Specifically not regulated in 40 CFR (433.1?) regulation. The table has a list of 126 compounds. If the concentration of a compound is > 0.1 mg/L then it is included in the total toxic organic calculation. If less than 100 ppb then it is not included.

APPENDIX B – REVISED SITE CLEAN-UP GOALS FROM 2008 ESD and SUMMARY OF CHANGES IN TOXICITY VALUES BETWEEN 2003 AND 2008 ESDs

TABLE 1
REVISED CLEAN-UP GOALS FOR SURFACE SOIL
SILRESIM SUPERFUND SITE, LOWELL, MASSACHUSETTS

Chemicals of Potential Concern	Current Silresim CUG from 2003 ESD (1) (mg/kg)	Risk-Based CUG for Surface Soil (2) (mg/kg)	MassDEP Method 3 Upper Concentration Limits (3) (mg/kg)	**Revised Site-Specific Surface Soil CUG (4) (mg/kg)**	Basis for Value
1,1,2,2-Tetrachloroethane	20	23	400	**23**	Risk-Based
Trichloroethene (5)	190	81	10,000	**81**	Risk-Based
1,2,4-Trimethylbenzene	73	73	-	**73**	Risk-Based
1,3,5-Trimethylbenzene	17	18	-	**18**	Risk-Based
Benzo(a)anthracene	50	50	3,000	**50**	Risk-Based
Benzo(a)pyrene	5	5.0	300	**5.0**	Risk-Based
Benzo(b)fluoranthene	50	50	3,000	**50**	Risk-Based
Dibenz(a,h)anthracene	5	5.0	300	**5.0**	Risk-Based
1,4-Dioxane	-	260	-	**260**	Risk-Based
Hexachlorobenzene	15	15	300	**15**	Risk-Based
1,2,4-Trichlorobenzene	18	150	9,000	**150**	Risk-Based
Arsenic	30	30	200	**30**	Risk-Based
Lead (6)	448	232	3,000	**380**	BKGD
Mercury	0.8	0.80	300	**0.80**	Risk-Based
2,3,7,8-TCDD (7)	0.0002	0.00034	0.003	**0.003**	MCP-UCL
Aroclor 1248	13	13	100	**13**	Risk-Based
Aroclor 1254	13	13	100	**13**	Risk-Based

(USEPA, 2008)

NOTES AND ABBREVIATIONS:

- = No Value Identified
CUG = Clean-up Goals
BKGD = Background Concentration
MCP-UCL = Massachusetts Contingency Plan - Upper Concentration Limits
(1) Current Silresim CUGs from the Explanation of Significant Differences, 2003.
(2) Risk-based CUGs assume a target risk goal of 1E-5 and target hazard index of 1 for each chemical.
(3) UCLs taken from MassDEP's MCP Numerical Standards Spreadsheets - January 2008 http://www.mass.gov/dep/service/compliance/riskasmt.htm
(4) The most stringent of the risk-based CUG or the UCL was taken as the recommended CUG for each chemical.
(5) Trichloroethylene CUG based on CalEPA toxicity value (2007)
(6) Value resulting from the application of the Adult Lead Model (ALM) used per correspondance with Region 1 Risk Assessor (6/11/07)
(7) Current toxicological carcinogenic slope factor for dioxin published in CalEPA
Revised CUG more stringent

TABLE 2
REVISED CLEAN-UP GOALS FOR SUBSURFACE SOIL
SILRESIM SUPERFUND SITE, LOWELL, MASSACHUSETTS

Chemicals of Potential Concern	Current Silresim CUG from 2003 ESD (1) (mg/kg)	Risk-Based CUGs for Subsurface Soil (2) (mg/kg)	MassDEP Method 3 Upper Concentration Limits (3) (mg/kg)	**Revised Site-Specific Subsurface Soil CUG (4) (mg/kg)**	Basis for Value
Benzene	0.04	68	9,000	**68**	Risk-based
Chlorobenzene	1.2	270	10,000	**270**	Risk-based
Chloroform	0.015	69	5,000	**69**	Risk-based
1,2-Dichloroethane	0.031	440	6,000	**440**	Risk-based
1,1-Dichloroethene	0.005	220	10,000	**220**	Risk-based
Ethylbenzene	1.2	4,500	10,000	**4,500**	Risk-based
Methylene Chloride	0.56	2,100	10,000	**2,100**	Risk-based
Styrene	290	11,000	10,000	**10,000**	MCP-UCL
1,1,2,2-Tetrachloroethane	0.16	140	400	**140**	Risk-based
Tetrachloroethene	0.85	210	10,000	**210**	Risk-based
Toluene	11	14,000	10,000	**10,000**	MCP-UCL
1,1,1-Trichloroethane	13	4,000	10,000	**4,000**	Risk-based
1,1,2-Trichloroethane	0.12	240	2,000	**240**	Risk-based
Trichloroethene (5)	0.25	81	10,000	**81**	Risk-based
Vinyl Chloride	0.0062	110	300	**110**	Risk-based
1,2-Dichlorobenzene	75	2,500	10,000	**2,500**	Risk-based
1,4-Dioxane	-	1,600	-	**1,600**	Risk-based
Hexachlorobenzene	6	140	300	**140**	Risk-based
Naphthalene	16	140	10,000	**140**	Risk-based
1,2,4-Trichlorobenzene	1	150	9,000	**150**	Risk-based
Lead (6)	448	232	3,000	**380**	Risk-based
Mercury	0.77	0.80	300	**0.80**	Risk-based
2,3,7,8-TCDD (7)	0.0002	0.0048	0.003	**0.003**	MCP-UCL
Aroclor 1242	13	13	100	**13**	Risk-based

(USEPA, 2008)

NOTES AND ABBREVIATIONS:

- = No Value Identified
CUG = Clean-up Goals
MCP-UCL = Massachusetts Contingency Plan - Upper Concentration Limits
(1) Current Silresim CUGs from the Explanation of Significant Differences, 2003.
(2) Risk-based CUGs assume a target risk goal of 1E-5 and target hazard index of 1 for each chemical.
(3) MADEP UCLs taken from MCP Numerical Standards Spreadsheets - January 2008 http://www.mass.gov/dep/service/compliance/riskasmt.htm
(4) The most stringent of the risk-based CUG or the UCL was taken as the recommended CUG for each chemical.
(5) Trichloroethylene CUG based on CalEPA toxicity value (2007)
(6) Value resulting from the application of the Adult Lead Model (ALM) used per correspondance with Region 1 Risk Assessor (6/11/07)
(7) Current toxicological carcinogenic slope factor for dioxin published in CalEPA.
Revised CUG more stringent
Revised CUG less stringent

TABLE 3
REVISED CLEAN-UP GOALS FOR GROUNDWATER
SILRESIM SUPERFUND SITE, LOWELL, MASSACHUSETTS

Chemicals of Potential Concern	Current Silresim CUG from 2003 ESD (1) (mg/L)	Risk-Based Clean-up Goal for Groundwater (2) (mg/L)	MassDEP Method 1 GW-3 Standard (3) (mg/L)	MassDEP Method 3 Upper Concentration Limits (3) (mg/L)	**Recommended Site-Specific Groundwater CUG (4) (mg/L)**	Basis for Value
Acetone	50	4,100	50	100	**50**	MCP GW-3
Benzene	0.48	5.6	10	100	**5.6**	Risk-based
Chlorobenzene	0.5	14	1	10	**1**	MCP GW-3
Chloroform	0.2	9.3	10	100	**9.3**	Risk-based
1,2-Dichloroethane	0.5	7.7	20	100	**7.7**	Risk-based
1,1-Dichloroethene	0.015	47	30	100	**30**	MCP GW-3
1,2-Dichloroethene (total)	120	58	-	100	**58**	Risk-based
cis-1,2-Dichloroethene	50	3,500	50	100	**50**	MCP GW-3
Ethylbenzene	3.4	67	4	100	**4**	MCP GW-3
Hexachlorobutadiene	0.041	0.041	3	30	**0.041**	Risk-based
Methylene Chloride	14	240	-	100	**100**	MCP-UCL
1,1,2,2-Tetrachloroethane	0.61	3.0	50	100	**3.0**	Risk-based
Tetrachloroethene	5	1.1	30	100	**1.1**	Risk-based
1,2,3-Trichlorobenzene	3.8	1.0	-	-	**1.0**	Risk-based
1,1,1-Trichloroethane	50	620	20	100	**20**	MCP GW-3
1,1,2-Trichloroethane	1.1	11	50	100	**11**	Risk-based
Trichloroethene (5)	1.4	0.87	5	50	**0.87**	Risk-based
Vinyl Chloride	0.13	7.9	50	100	**7.9**	Risk-based
1,4-Dioxane	-	37	-	-	**37**	Risk-based
Naphthalene	0.89	0.89	20	100	**0.89**	Risk-based
1,2,4-Trichlorobenzene	0.15	1.0	50	100	**1.0**	Risk-based
Arsenic	0.4	31	0.9	9	**0.90**	MCP GW-3
Cadmium (water)	0.01	2.6	0.004	0.05	**0.004**	MCP GW-3
Lead	0.03	-	0.01	0.15	**0.01**	MCP GW-3
Nickel	0.08	410	0.2	2	**0.2**	MCP GW-3

(USEPA, 2008)

NOTES AND ABBREVIATIONS:

- = No Value Identified

CUG = Clean-Up Goal

MCP GW-3 = Established to be the Massachusetts Contingency Plan Groundwater 3 Standard for the protection of ecological resources.

MCP UCL= Established to be the Massachusetts Contingency Plan Upper Concentration Limit.

(1) Current Silresim CUGs from the Explanation of Significant Differences, 2003.

(2) Risk-based CUGs assume a target risk goal of 1E-5 and target hazard index of 1 for each chemical.

(3) MassDEP GW-3 Standards (310 CMR40.0974(2) Table 1) and UCLs (310 CMR 40.0996(7) Table 6) were included as possible ARAR for the site.

(4) The most stringent of the risk-based CUG, the GW-3 value, or the UCL was taken as the recommended CUG for each chemical.

(5) Trichloroethylene CUG based on CalEPA toxicity value (2007).

Revised CUG more stringent

Revised CUG less stringent

Table 4 Summary of Changes in Toxicity Values Between 2003 and 2008 ESDs

Substance	Date of Change	RfD_{oral} (mg/kg - day)	RfC (ug/m^3)	CSF_{oral} $(mg/kg\text{-}day)^{-1}$	Unit Risk $(ug/m^3)^{-1}$
		Current	Current	Current	Current
Acetone[7]	12/21/07	- -	1.3 E+4		
Bis(2-ehtylhexyl) phthalate [3]	NA	- -	- -	- -	NA
Chlorobenzene [1]	9/17/07	7.0 E-2	5.0 E+1	- -	- -
Chloroform [7]	12/21/07	- -	9.92E+1	- -	- -
1,2-Dicholorethane[7]	12/21/07	- -	2.47E+3	- -	- -
1,1-Dichlorethene [3]	NA	- -	- -	- -	NA
*trans*1,2-dichloroethene [1]	9/17/07	- -	6.0E+1	- -	- -
4,4'-DDE[4]	12/17/07	- -	- -	- -	4.0E-5
1,4-Dioxane [2, 3]	12/18/07	- -	- -	7.7E-6	- -
Toluene [2]	9/18/07	8E-2	5.0E+3	- -	- -
1,1,1-trichloroethane[5]	4/23/08	2.0E+0		- -	- -
1,1,2-trichloroethane[1]	4/23/08	4.0E-3		- -	- -
Lindane (gamma BHC)[3]	NA	- -	- -	- -	NA
Methylene Chloride [7]	12/21/07	- -	1.06E+3	- -	- -
n-Propylbenzene[2, 3,11]	5/12/05	NA		- -	- -
2,3,7,8-TCDD[4, 610]	9/19/07 12/21/07	- -	- -	1.3E+5	3.3E-5
1,2,3-Trichlorobenzene [8]	10/01/07		4.0E 00		
1,2,4-Trichlorobenzene [8]	10/01/07		4.0E 00		
Tetrachloroethene [4]	12/21/07	- -	2.76E+2	- -	- -
Trichloroethene [4,5]	12/17/07	- -	- -	- -	2.0E-6
$C_5 – C_8$Aromatics [9]	11/03	- -	2.0E+1	- -	- -
$C_9 – C_{18}$Aromatics [9]	11/03				
$C_9 – C_{18}$Aromatics [9]	11/03		5.0E+1		
Aluminum[1]	9/17/07	1.0E+0	5E+0		
Barium [2,10]	9/18/07 12/21/07	2.0E-1	5E-1		
Cadmium[2,3]	9/18/07	- -	- -	NA	
Nickel [2]	12/18/07	- -	- -	- -	2.4E-4

Exposure routes included in the remedy are ingestion, inhalation and dermal contact.
NA - not applicable
RfD_{ora}l - reference dose for noncancer health effects resulting from oral exposure.
CSF_{oral} - cancer slope factor for cancer health effects resulting from oral exposure.
1 PPTRV – Provisional Peer Reviewed Toxicity Values (USEPA)
2 – IRIS – Integrated Risk Information System
3 -now unquantified - no value supported
4 – CalEPA – State of California Environmental Protection Agency
5- USEPA
6- Dioxin Reassessment
7-ATSDR – Agency for Toxic Substances and Disease Registry
8-NCEA – National Center for Environmental Assessment
9 –MassDEP 2002. Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of MADEP VPH/EPH Approach. October 31, 2002 cited in the 2008 Supplemental CUG had only a background estimate for $C_9 – C_{18}$Aromatics. However, the Final Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology, MassDEP, November 2003 had toxicity values for the various aromatic carbons which are cited in this Five Year Review
10 –HEAST – Health Effects Assessment Summary (USEPA, 1997)
11- EPA Superfund Technical Support Center

APPENDIX C – SITE INSPECTION CHECKLIST

Five-Year Review Site Inspection Checklist
Silresim Superfund Site, Lowell, Massachusetts

("N/A" refers to "not applicable")

I. SITE INFORMATION	
Site name: Silresim Superfund Site	**Date of inspection:** 25 November 2008
Location and Region: Lowell, Massachusetts, USEPA Region I	**EPA ID:** MAD000192393
Agency, office, or company leading the five-year review: United States Army Corps of Engineers New England District	**Weather/temperature:** Rainy/cool ~ 45^{0}F

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment ☐ Monitored natural attenuation
☐ Access controls ☐ Groundwater containment
■ Institutional controls ☐ Vertical barrier walls
■ Groundwater pump and treatment
☐ Surface water collection and treatment
☐ Other____

Attachments: ■ Inspection team roster attached (in report) ■ Site map attached (in report)

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Steve Daigle (Name) Chief Operator (Title) 25 November 2008 (Date)
   Interviewed ■ at site ☐ at office ☐ by phone Phone no. ___________
   Problems, suggestions; The air stripper pH read-out is currently not working

2. **O&M staff** Russ Garrison (Name) O&M Staff (Title) 25 November 2008 (Date)
   Interviewed ■ at site ☐ at office ☐ by phone Phone no. _____________
   Problems, suggestions; ϒ Report attached ______________________________

3.	**Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply. Agency MassDEP Contact Janet Waldron / Project Manager / 11-25-08 / 617-556-1156 Name / Title / Date / Phone no. Problems; suggestions; ■ Report attached Agency USEPA, Region 1 Contact Dan Keefe / Remedial Project Manager / 11-25-08 / 617-918-1327 Name / Title / Date / Phone no. Problems; suggestions; ☐ Report attached Agency Contact Name / Title / Date / Phone no. Problems; suggestions; ☐ Report attached Agency Contact Name / Title / Date / Phone no. Problems; suggestions; ☐ Report attached
4.	**Other interviews** (optional) ☐ Reports attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	■ O&M manual	■ Readily available	■ Up to date	☐ N/A
	■ As-built drawings	■ Readily available	■ Up to date	☐ N/A
	■ Maintenance logs	■ Readily available	■ Up to date	☐ N/A
	Remarks ______			
2.	**Site-Specific Health and Safety Plan**			
	■ Contingency plan/emergency response plan	■ Readily available	■ Up to date	☐ N/A
	Remarks ______			
3.	**O&M and OSHA Training Records**	■ Readily available	■ Up to date	☐ N/A
	Remarks ______			
4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	■ N/A
	■ Effluent discharge	■ Readily available	■ Up to date	☐ N/A
	■ Waste disposal, POTW	■ Readily available	■ Up to date	☐ N/A
	■ Other permits Dumpster for the City	■ Readily available	■ Up to date	☐ N/A
	Remarks ______			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks ______			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks ______			
7.	**Groundwater Monitoring Records**	■ Readily available	■ Up to date	☐ N/A
	Remarks Available in Status Reports			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks ______			
9.	**Discharge Compliance Records**			
	■ Air	■ Readily available	■ Up to date	☐ N/A
	■ Water (effluent)	■ Readily available	■ Up to date	☐ N/A
	Remarks Air discharge memo			
10.	**Daily Access/Security Logs**	■ Readily available	■ Up to date	☐ N/A
	Remarks ______			

IV. O&M COSTS
1. **O&M Organization** ☐ State in-house ■ Contractor for State ☐ PRP in-house ☐ Contractor for PRP ☐ Federal Facility in-house ☐ Contractor for Federal Facility ☐ Other________________________________
2. **O&M Cost Records** ☐ Readily available ■ Up to date ☐ Funding mechanism/agreement in place Original O&M cost estimate__________________ ■ Breakdown attached Total annual cost by year for review period if available From ________ ________ ________ From ________ ________ ________ From ________ ________ ________ Date Total Cost From ________ ________ ________ Date Total Cost From ________ ________ ________ Date Total Cost
3. **Unanticipated or Unusually High O&M Costs During Review Period**
V. ACCESS AND INSTITUTIONAL CONTROLS ϒ Applicable ϒ N/A
A. Fencing
1. **Fencing** ■ Location shown on site map ■Gates secured ☐ N/A Remarks Fence surrounding Silresim Site is in good condition, 8' tall.
B. Other Access Restrictions
1. **Signs and other security measures** ■ Location shown on site map ☐ N/A Remarks. Signs in good condition

C. Institutional Controls (ICs)	
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ■ N/A Type of monitoring (*e.g.*, self-reporting, drive by) Frequency Institutional Controls exist in the form Responsible party/agency EPA Contact ________________________________ Name Title Date Phone no. Reporting is up-to-date ☐ Yes ☐ No ☐ N/A Reports are verified by the lead agency ☐ Yes ☐ No ☐ N/A Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☐ N/A Violations have been reported ☐ Yes ☐ No ☐ N/A Other problems or suggestions: ☐ Report attached Institutional Controls are in place in the form of Easements in documents titles "Grant of Easements and Restrictions Agreement" dated 1993-1994.
2.	**Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks ICs may need to be updated to reflect current land owners of abutting properties
D. General	
1.	**Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident Remarks ________________________________
2.	**Land use changes on site** ■ N/A Remarks________________________________
3.	**Land use changes off site** ☐ N/A Remarks There may be a new power plant going in adjacent to the Site to the northeast
VI. GENERAL SITE CONDITIONS	
A. Roads ■ Applicable ☐ N/A	
1.	**Roads damaged** ■ Location shown on site map ■ Roads adequate ☐ N/A Remarks Tanner Street is in need of repair

B. Other Site Conditions
Remarks ____

VII. LANDFILL COVERS ☐ Applicable ■ N/A CAP			
A. Landfill Surface			
1.	**Settlement** (Low spots) Areal extent______________ Remarks______________________	☐ Location shown on site map Depth____________	■ Settlement not evident
2.	**Cracks** Lengths____________ Widths___________ Depths__________ Remarks______________________	☐ Location shown on site map	■ Cracking not evident
3.	**Erosion** Areal extent______________ Remarks______________________	☐ Location shown on site map Depth____________	■ Erosion not evident
4.	**Holes** Areal extent______________ Remarks______________________	☐ Location shown on site map Depth____________	■ Holes not evident
5.	**Vegetative Cover** ☐ Grass ■ Cover properly established ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks______________________		
6.	**Alternative Cover (armored rock, concrete, etc.)** ☐ N/A Remarks asphalt, gravel		
7.	**Bulges** Areal extent______________ Remarks______________________	☐ Location shown on site map Height____________	■ Bulges not evident

8. **Wet Areas/Water Damage**	■ Wet areas/water damage not evident		
☐ Wet areas	☐ Location shown on site map	Areal extent______________	
☐ Ponding	☐ Location shown on site map	Areal extent______________	
☐ Seeps	☐ Location shown on site map	Areal extent______________	
☐ Soft subgrade	☐ Location shown on site map	Areal extent______________	
Remarks____			
9. **Slope Instability** ☐ Slides	☐ Location shown on site map	■ No evidence of slope instability	
Areal extent______________			
Remarks____			
B. Benches ☐ Applicable ■ N/A			
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)			
1. **Flows Bypass Bench**	☐ Location shown on site map	■ N/A or okay	
Remarks____			
2. **Bench Breached**	☐ Location shown on site map	■ N/A or okay	
Remarks____			
3. **Bench Overtopped**	☐ Location shown on site map	■ N/A or okay	
Remarks____			
C. Letdown Channels ☐ Applicable ■ N/A			
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)			
1. **Settlement**	☐ Location shown on site map	☐ No evidence of settlement	
Areal extent______________	Depth____________		
Remarks____			
2. **Material Degradation**	☐ Location shown on site map	☐ No evidence of degradation	
Material type_______________	Areal extent_____________		
Remarks____			
3. **Erosion**	☐ Location shown on site map	☐ No evidence of erosion	
Areal extent______________	Depth____________		
Remarks____			

4.	**Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting Areal extent______________ Depth____________ Remarks____
5.	**Obstructions** Type_____________________ ☐ No obstructions ☐ Location shown on site map Areal extent______________ Size____________ Remarks____
6.	**Excessive Vegetative Growth** Type____________________ ☐ No evidence of excessive growth ☐ Vegetation in channels does not obstruct flow ☐ Location shown on site map Areal extent______________ Remarks____
D. Cover Penetrations ■ Applicable ☐ N/A	
1.	**Gas Vents** ☐ Active ϒ Passive ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ■ N/A Remarks____
2.	**Gas Monitoring Probes** ☐ Properly secured/locked ϒ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ■ N/A Remarks____
3.	**Monitoring Wells** (within surface area of landfill) ■ Properly secured/lockedϒ Functioning ■ Routinely sampled ■ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks <u>Wells inside Site – are unlocked, wells outside – are locked</u>
4.	**Leachate Extraction Wells** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ■ N/A Remarks____
5.	**Settlement Monuments** ☐ Located ☐ Routinely surveyed ■ N/A Remarks____

E. Gas Collection and Treatment ☐ Applicable ■ N/A		
1.	**Gas Treatment Facilities** ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse ☐ Good condition ϒ Needs Maintenance Remarks________________________________	
2.	**Gas Collection Wells, Manifolds and Piping** ☐ Good condition ☐ Needs Maintenance Remarks________________________________	
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) ☐ Good condition ϒ Needs Maintenance ☐ N/A Remarks________________________________	
F. Cover Drainage Layer ☐ Applicable ■ N/A		
1.	**Outlet Pipes Inspected** ☐ Functioning ☐ N/A Remarks________________________________	
2.	**Outlet Rock Inspected** ☐ Functioning ☐ N/A Remarks________________________________	
G. Detention/Sedimentation Ponds ☐ Applicable ■ N/A		
1.	**Siltation** Areal extent______________ Depth____________ ☐ N/A ϒ Siltation not evident Remarks________________________________	
2.	**Erosion** Areal extent______________ Depth____________ ☐ Erosion not evident Remarks________________________________	
3.	**Outlet Works** ☐ Functioning ☐ N/A Remarks________________________________	
4.	**Dam** ☐ Functioning ☐ N/A Remarks________________________________	

H. Retaining Walls ☐ Applicable ■ N/A	
1.	**Deformations** ☐ Location shown on site map ☐Deformation not evident Horizontal displacement_____________ Vertical displacement________________ Rotational displacement_____________ Remarks____
2.	**Degradation** ☐ Location shown on site map ☐ Degradation not evident Remarks____
I. Perimeter Ditches/Off-Site Discharge ■ Applicable ☐ N/A	
1.	**Siltation** ☐ Location shown on site map ☐ Siltation not evident Areal extent_______________ Depth_____________ Remarks Swales – Surface water discharge to River Meadow Brook
2.	**Vegetative Growth** ☐ Location shown on site map ☐ N/A ■ Vegetation does not impede flow Areal extent_______________ Type_____________ Remarks____
3.	**Erosion** ☐ Location shown on site map ■ Erosion not evident Areal extent_______________ Depth_____________ Remarks____
4.	**Discharge Structure** ■ Functioning ☐ N/A Remarks Head wall at River Meadow Brook
VIII. VERTICAL BARRIER WALLS ☐ Applicable ■ N/A	
1.	**Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent_______________ Depth_____________ Remarks____
2.	**Performance Monitoring** Type of monitoring___________________________ ☐ Performance not monitored Frequency_________________________________ ☐ Evidence of breaching Head differential___________________________ Remarks____

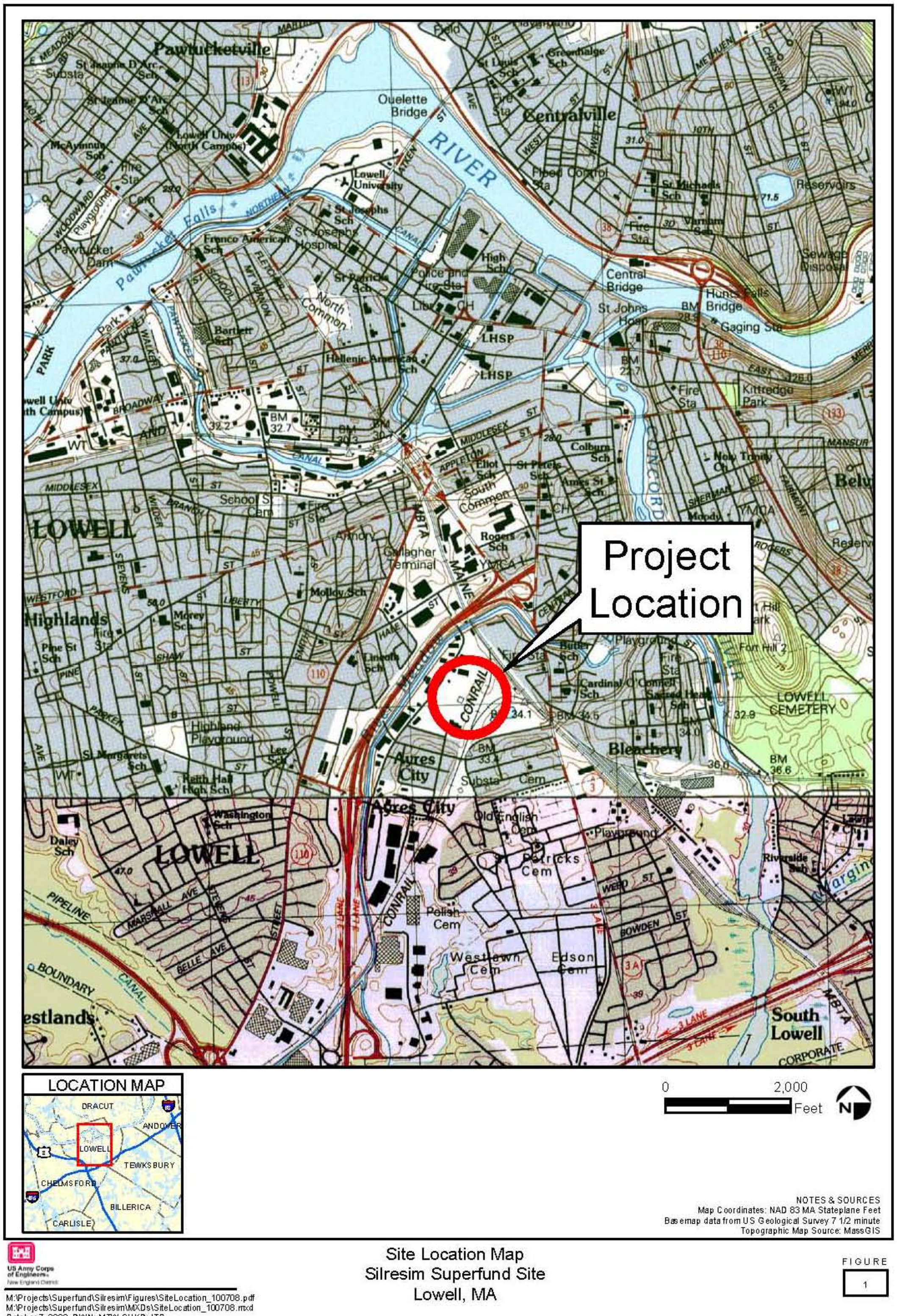
IX. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines ■ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks Well sampling scheduled for next month
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ■ Good condition ☐ Needs Maintenance Remarks
3. **Spare Parts and Equipment** ☐ Readily available ■ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks Parts for potential optimization, many spare parts available. Preventative maintenance is performed.
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ■ N/A
1. **Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks
3. **Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks

C. Treatment System ■ Applicable ☐ N/A	
1.	**Treatment Train** (Check components that apply) ■ Metals removal ☐ Oil/water separation: not in use ☐ Bioremediation ■ Air stripping ■ Carbon adsorbers: not in use ■ Filters pressure filters ■ Additive (*e.g.*, chelation agent, flocculent) NaOH, NaOCl, polymer ■ Others anti-foam (Foamtrol) ■ Good condition ☐ Needs Maintenance ■ Sampling ports properly marked and functional ■ Sampling/maintenance log displayed and up to date ■Equipment properly identified Quantity of groundwater treated annually Approximately 9.3 million gallons * Quantity of surface water treated annually N/A Remarks * Information from Status Report No. 32
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ■ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks
4.	**Discharge Structure and Appurtenances** ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks
5.	**Treatment Building(s)** ☐ N/A ■ Good condition ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks There is an odor in the GWTP that may need to be identified and properly vented
6.	**Monitoring Wells** (pump and treatment remedy) ■ Properly secured/locked ■ Functioning ■Routinely sampled ■ Good condition ■ All required wells located ☐ Needs Maintenance ☐ N/A Remarks
D. Monitoring Data	
1.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
2.	Monitoring data suggests: Contaminated groundwater is not adequately contained in the north area of the Site. Some contaminant concentrations are declining and others are increasing ☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

D. Monitored Natural Attenuation
1. **Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ■ N/A Remarks ____________________
X. OTHER REMEDIES
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.
X. OVERALL OBSERVATIONS
A. Implementation of the Remedy
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).
B. Adequacy of O&M
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.
C. Early Indicators of Potential Remedy Problems
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. ____________________ ____________________ ____________________ ____________________ ____________________
D. Opportunities for Optimization
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. ____________________ ____________________ ____________________ ____________________ ____________________

APPENDIX D – FIGURES

Figure 1. Site location map for Silresim Superfund Site, City of Lowell, Massachusetts



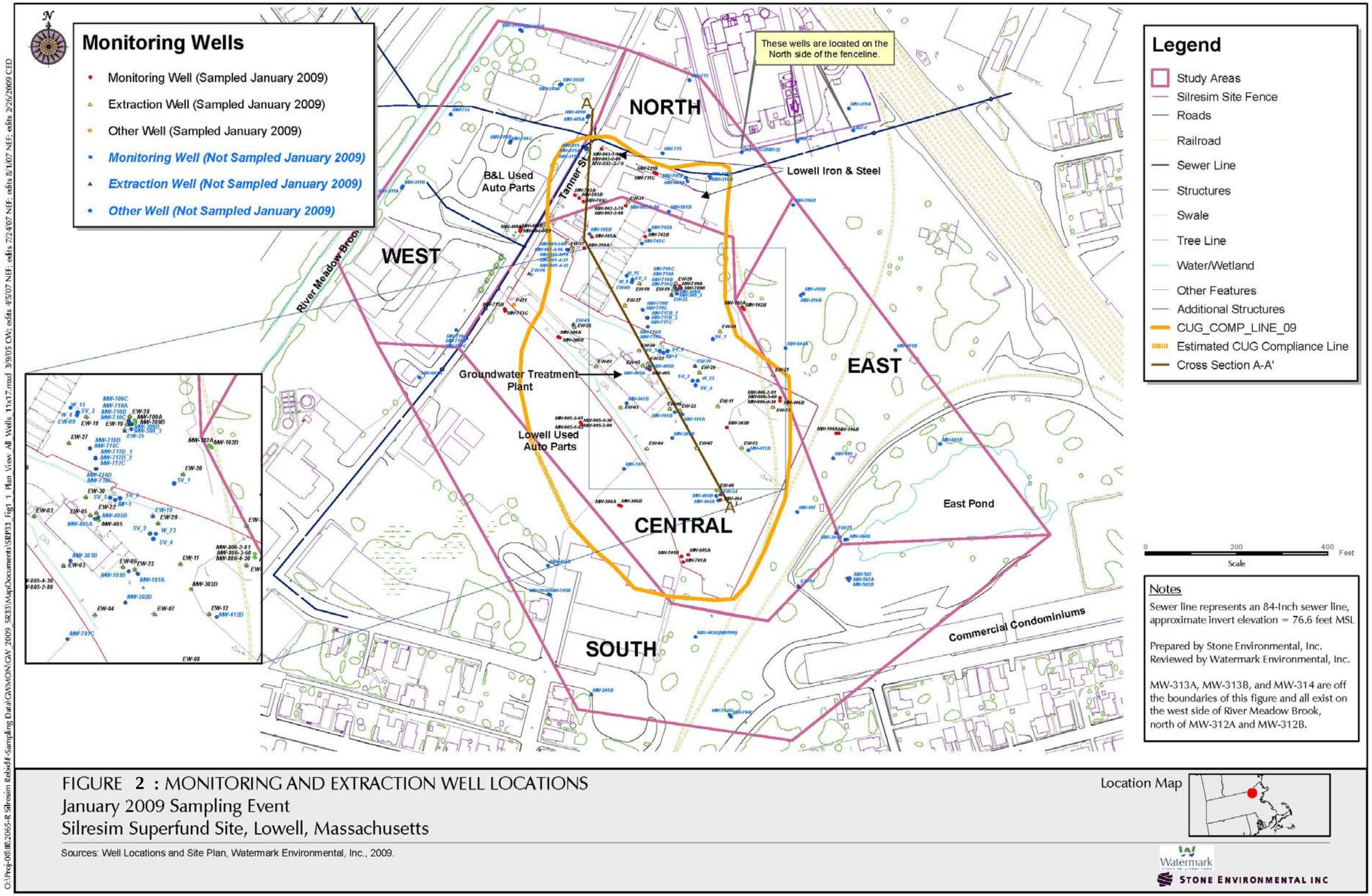

Monitoring Wells
Monitoring Well (Sampled January 2009)
Extraction Well (Sampled January 2009)
Other Well (Sampled January 2009)
Monitoring Well (Not Sampled January 2009)
Extraction Well (Not Sampled January 2009)
Other Well (Not Sampled January 2009)
These wells are located on the North side of the fenceline.
NORTH
WEST
EAST
CENTRAL
SOUTH
B&L Used Auto Parts
Lowell Iron & Steel
Tanner St.
River Meadow Brook
Groundwater Treatment Plant
Lowell Used Auto Parts
East Pond
Commercial Condominiums
Legend
Study Areas
Silresim Site Fence
Roads
Railroad
Sewer Line
Structures
Swale
Tree Line
Water/Wetland
Other Features
Additional Structures
CUG_COMP_LINE_09
Estimated CUG Compliance Line
Cross Section A-A'
0
200
400
Feet
Scale
Notes
Sewer line represents an 84-Inch sewer line, approximate invert elevation = 76.6 feet MSL
Prepared by Stone Environmental, Inc.
Reviewed by Watermark Environmental, Inc.
MW-313A, MW-313B, and MW-314 are off the boundaries of this figure and all exist on the west side of River Meadow Brook, north of MW-312A and MW-312B.
FIGURE 2 : MONITORING AND EXTRACTION WELL LOCATIONS
January 2009 Sampling Event
Silresim Superfund Site, Lowell, Massachusetts
Sources: Well Locations and Site Plan, Watermark Environmental, Inc., 2009.
Location Map
Watermark
STONE ENVIRONMENTAL INC

Figure 3 Silresim Site Parcel Map

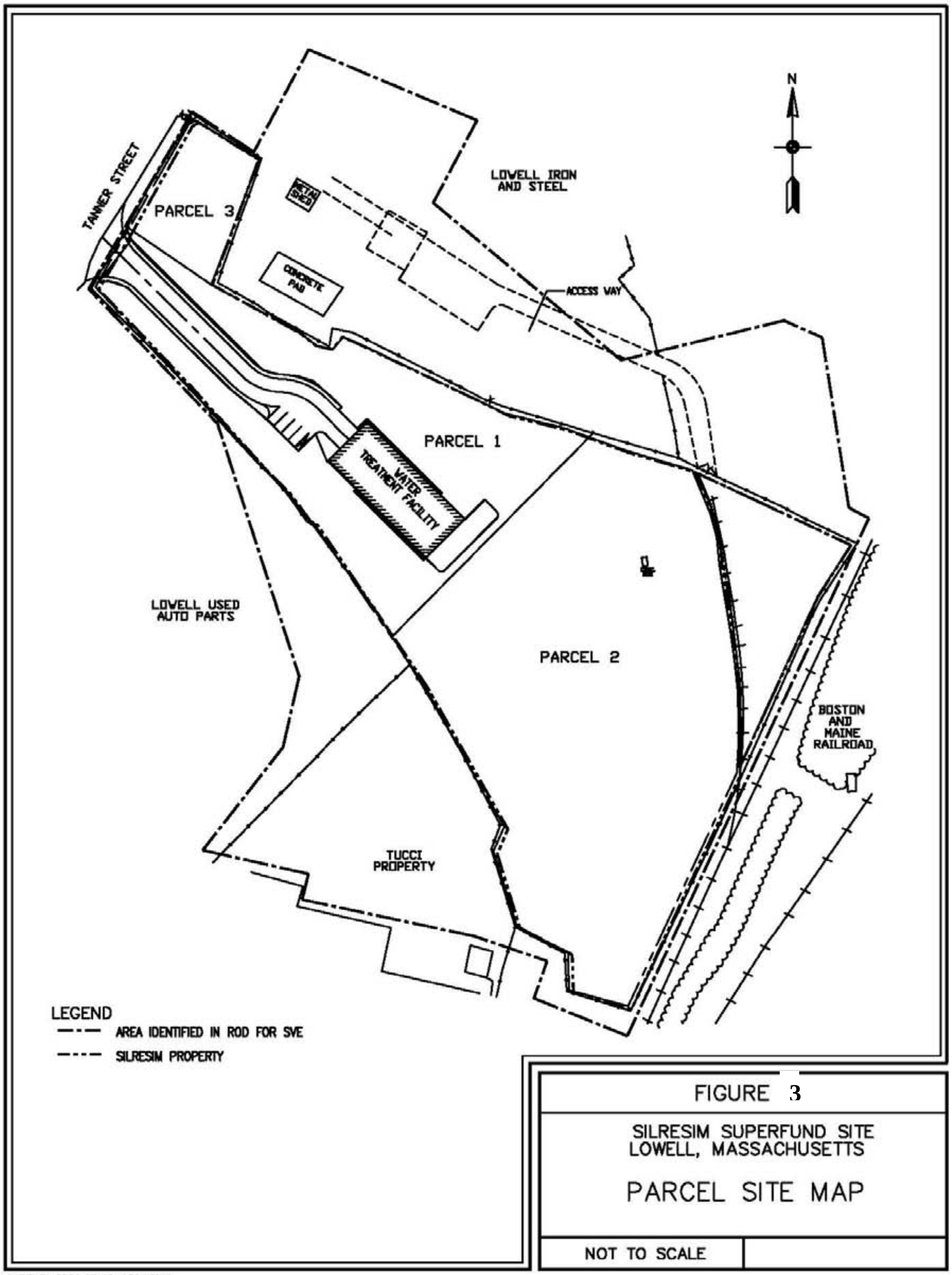
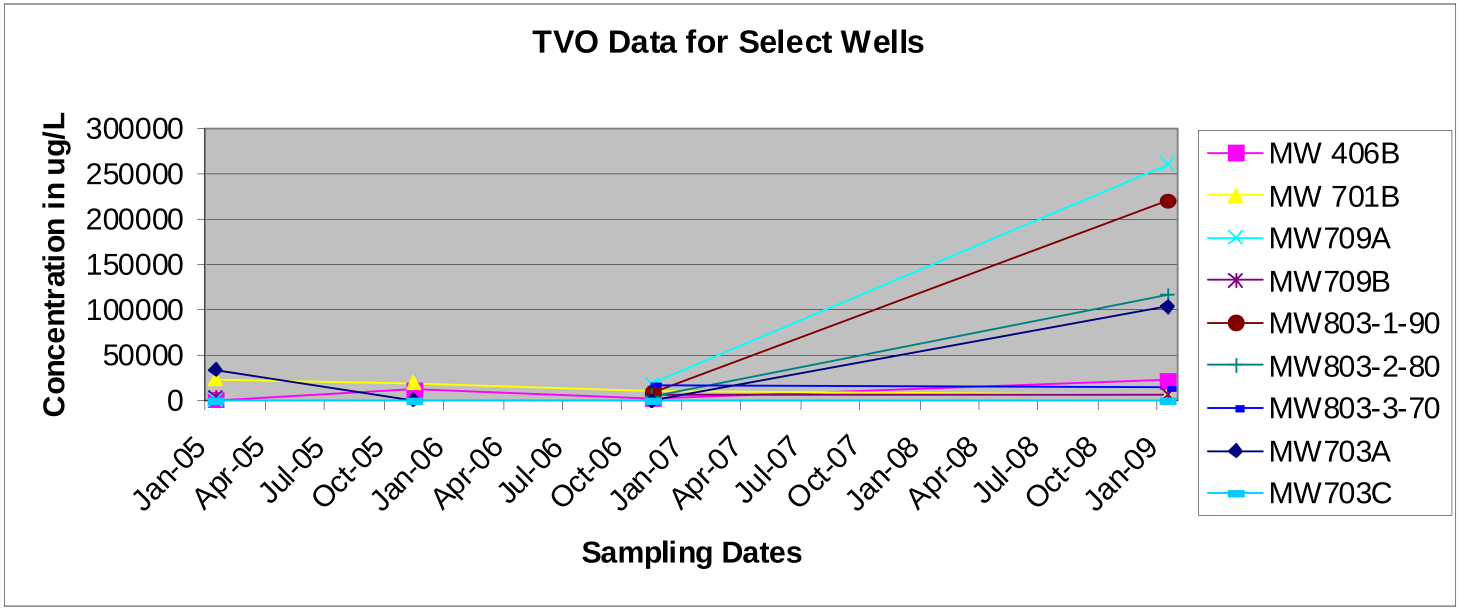


Figure 4. Total Volatile Organic Data for Select Silresim Wells



MW 406B - Central Study Area Layer 1

MW 701B - Central Study Area Layer 3

MW 709A - Central Study Area Layer 5

MW 709B - Central Study Area Layer 3

MW803-1-90 - North Study Area Layer 1

MW803-2-80 - North Study Area Layer 2

MW803-3-70 - North Study Area Layer 3

MW703A – North Study Area Layer 4

MW 703C - North Study Area Layer 1

Figure 5 Cross Section

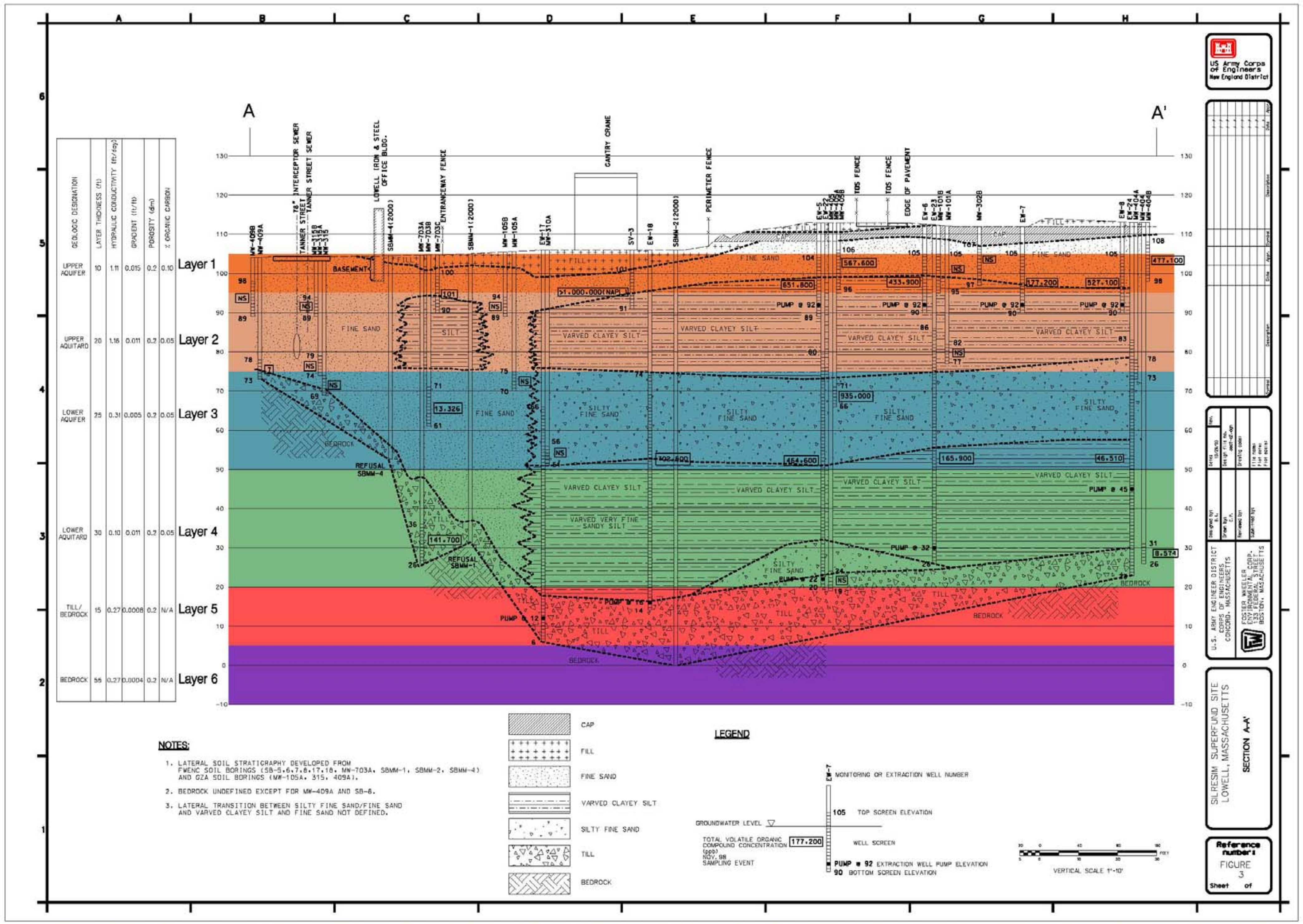
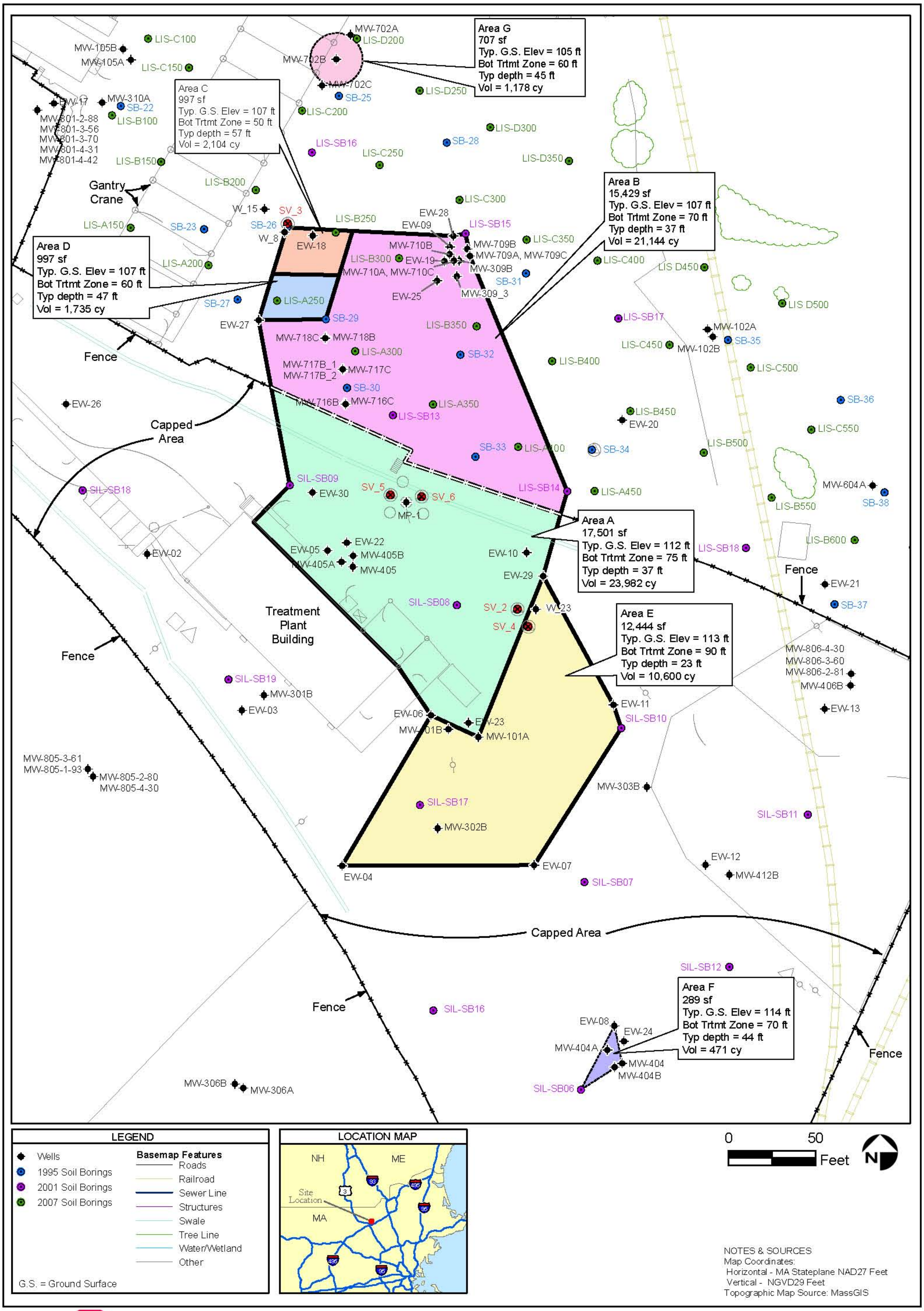


Figure 6 Proposed Thermal Treatment Zones



US Army Corps of Engineers New England District

M:\Projects\Superfund\Silresim\Figures\TreatmentAreas_Portrait_092208.pdf
M:\Projects\Superfund\Silresim\MXDs\TreatmentAreas_Portrait_092208.mxd
September 22, 2008 DWN: MTW CHKD: RAS

Proposed Thermal Treatment Zones
Figure **6**
Silresim Superfund Site
Lowell, MA

APPENDIX E – SUMMARY OF SELECTED EXPOSURE PARAMETERS

Appendix E
Table 1
Summary of Selected Exposure Parameters

Environmental Medium	Receptor	Exposure Routes	Exposure Parameters*	Reference
Surface Soil Subsurface Soil	Commercial /Industrial Worker	Ingestion Dermal Inhalation*	EF – 150 days ED – 25 years IRsoil – 100 mg/day SAdermal – 3300 cm2 PEF – 1.31×10^9 m^3/kg VF – calculated	1 1 1 1 2 1
Surface Soil	Trespasser	Ingestion Dermal Inhalation	EF – 120 days ED – 12 years IRsoil – 100 mg/day SAdermal – 5800 cm2 PEF – 1.31×10^9 m^3/kg VF – calculated	3 4 3 4 2 1
Surface Soil Subsurface Soil	Construction Worker	Ingestion Dermal Inhalation	EF – 130 days ED – 1 year IR – 200 mg/day SA – 3300 cm2 PEF – 1.7×10^6 m^3/kg	1 1 1 1 4
Surface Soil Subsurface Soil	Utility Worker	Ingestion Dermal Inhalation	EF – 5 days/year ED – 25 years IR – 200 mg/day SA – 3300 cm2 PEF – 1.7×10^6 m^3/kg	4 4 4 4 1
Groundwater	Construction Worker	Dermal Inhalation	EF – 130 days ED – 1 year SA – 3300 cm2 VF – Calculated	1 1 1 4

1 - Technical Memorandum, Supplemental Clean-Up Goal Evaluation, May 5, 2008 Appendix B
2 - US EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites
3 - Technical Memorandum, Supplemental Clean-Up-Goal Evaluation, May 5, 2008, Table 9
4 - Final Additional Site Investigation and Revision of Site Clean-Up Goals, January 2002, Table 6-26
* Exposure Parameters
EF – Exposure Frequency
ED – Exposure Duration
IRsoil – Soil ingestion rate
SA – Surface Area for dermal exposure assessment
PEF – Particulate Exposure Factor
VF – Soil-to-Air Volatilization Factor
Additional Factors and Adult Lead Methodology application are found in the above references.